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NATIONAL GEOGRAPHIC

INSIDE
FREE MAP
THE TWO KOREAS

DIVIDED KOREA

FACE-OFF ALONG THE DMZ

U.S. NAVAL HISTORICAL CENTER

THE FORGOTTEN WAR

Three Long Years in Korea

September 1950
As Sherman tanks rumble in the background, U.S. Marines advance through the streets during the liberation of Seoul.

Produced by National Geographic Maps for National Geographic Magazine

NATIONAL GEOGRAPHIC

GILBERT M. GROSVENOR, CHAIRMAN
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ALLEN CARROLL, CHIEF CARTOGRAPHER

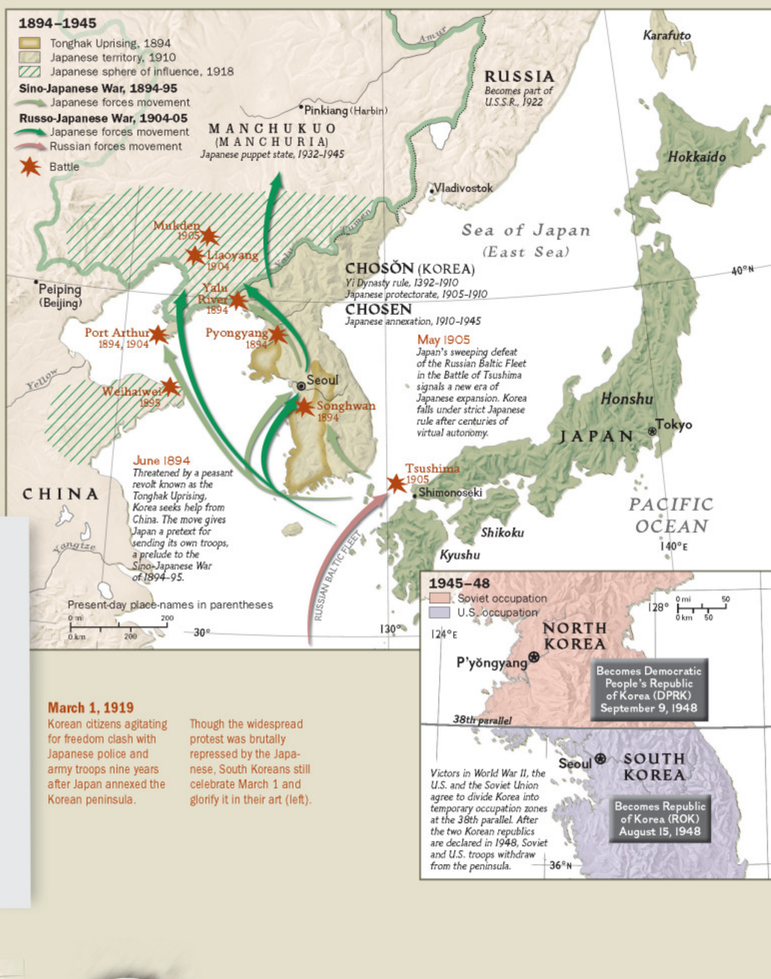
Washington, D.C., July 2003

"No division of a nation in the present world is so astonishing in its origin as the division of Korea." — Gregory Henderson, Korea scholar

In 1945 as World War II wound down, two U.S. Army colonels got a rush assignment: Draw a line through Korea dividing it into temporary occupation zones where the United States and Soviet Union would accept the surrender of Japanese forces. Poring over a map, they chose the 38th parallel. The Soviets agreed. This arbitrary line soon became entrenched, leaving each half of Korea fated to become a Cold War pawn. In 1948 the two Korean republics officially were born. Friction between the communist North and Western-allied South erupted into war when North Korea invaded in 1950. For three years the North, with Soviet backing and Chinese troops, fought a U.S.-led coalition of UN forces supporting the South. Each side gained and lost ground in battles to control the strategic peninsula. The cost: more than three million casualties by some estimates. Fifty years after the armistice that established the Demilitarized Zone (DMZ) redividing North and South, the two Koreas remain technically at war, locked in an unending stalemate.

1894–1948
FOREIGN PENETRATION

With Chinese help the kingdom of Silla unified much of what is now the Korean peninsula in A.D. 668. In the early tenth century a leader named Wang Kon founded the kingdom of Koryo, root of the word "Korea." For the next ten centuries Korea was essentially a unified nation despite invasions by Mongols, Japanese, and Manchus. Competition between China and Japan for domination of Korea led to the Sino-Japanese War of 1894-95. The Russo-Japanese War of 1904-05 ended with Korea as a Japanese protectorate. In 1910 Japan annexed the peninsula as a colony, a harsh domination that ended only with Japan's surrender to Allied forces in 1945. Korean euphoria at liberation turned to dismay when the country split into two quarreling halves.



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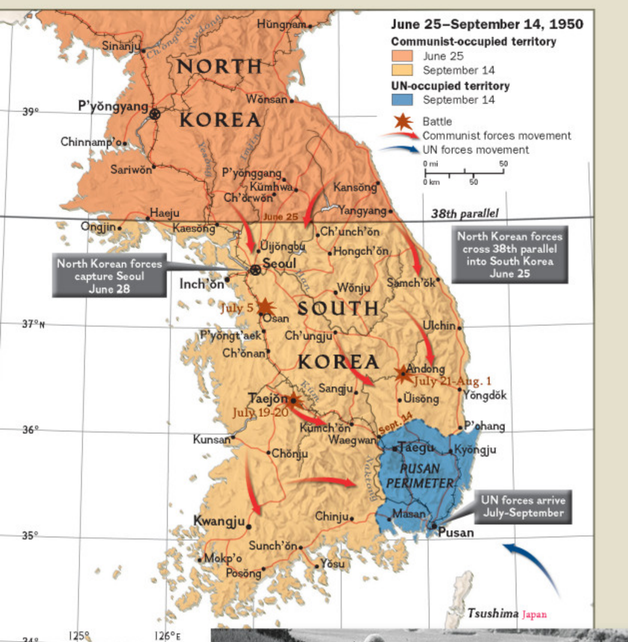
INDEPENDENCE HALL OF KOREA

March 1, 1919
Korean citizens agitating for freedom clash with Japanese police and army troops nine years after Japan annexed the Korean peninsula.

Though the widespread protest was brutally repressed by the Japanese, South Koreans still celebrate March 1 and glorify it in their art (left).

1 June 25—September 14, 1950
NORTH KOREA INVADES

In a bold effort to unify the country by force, North Korea staged a surprise invasion of the South on June 25, 1950. In just three days the attackers occupied the South's capital city, Seoul, and soon penetrated even farther below the 38th parallel. The UN responded by establishing a U.S.-led coalition to repel the invaders. In July U.S. ground troops joined South Korean forces fighting near Osan. By late summer the coalition forces had retreated to a fraction of the peninsula that came to be called the Pusan Perimeter, centered around the port city of Pusan. This port became a lifeline through which flowed the men and supplies needed for a counteroffensive.



August 1950
U.S. Marine stretcher bearers carry a wounded comrade near the Pusan Perimeter, a UN-held enclave bounded by northern mountains, the Naktong River, and the sea.

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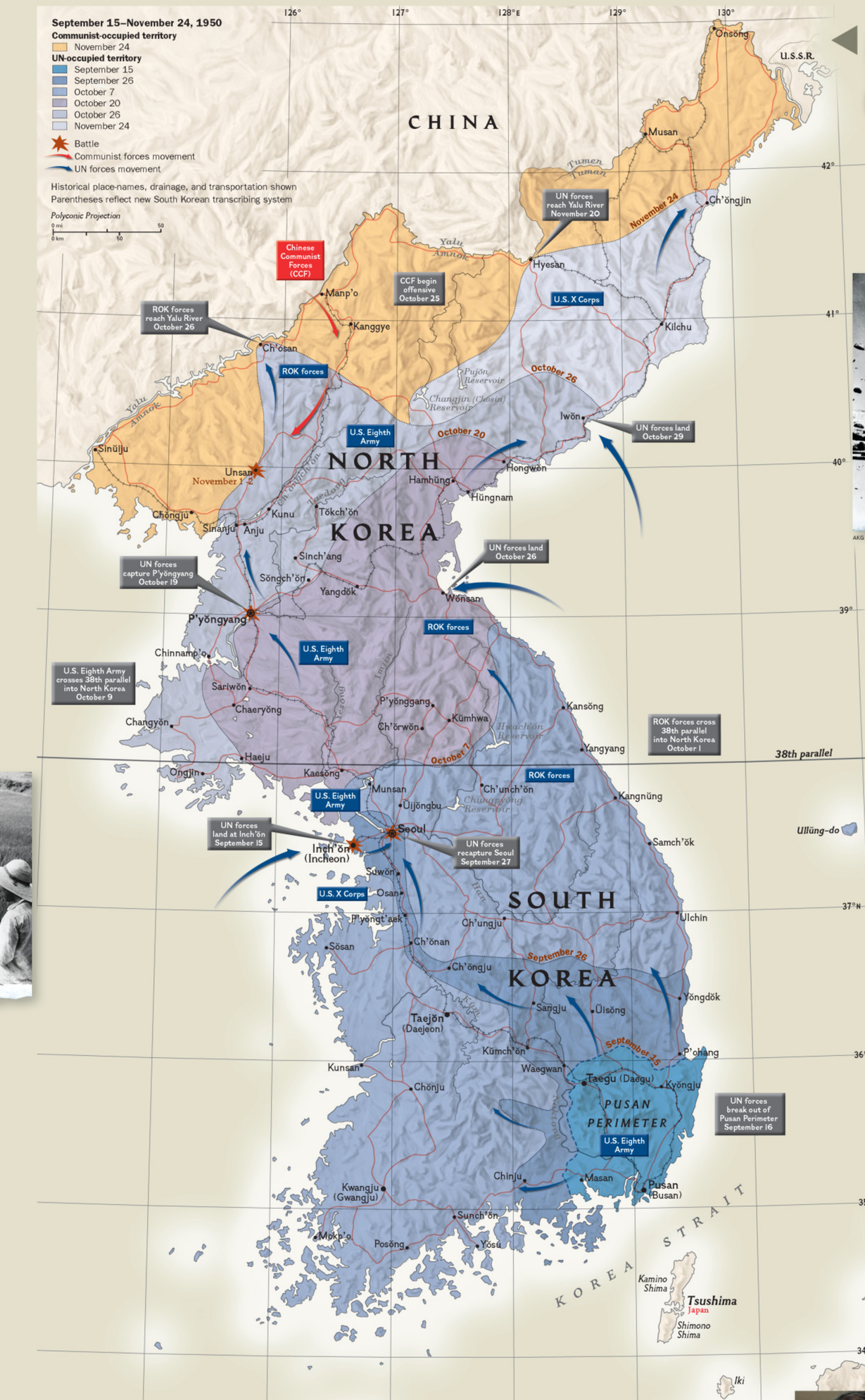

2 September 15—November 24, 1950
NORTH TO THE YALU

In an audacious gamble, UN troops commanded by U.S. Gen. Douglas MacArthur made an amphibious landing at the coastal city of Inchon on September 15. From there they moved on to recapture Seoul, cutting North Korea's communication and supply lines. In early October, MacArthur called for immediate surrender by North Korea, a demand rejected by its leader, Kim Il Sung. At the same time, UN forces crossed the 38th parallel and began to move north toward the Yalu River on China's border (a move that, as China had threatened, led it to enter the war against the South). On October 19 UN troops took North Korea's capital, Pyongyang. MacArthur claimed the troops might be "home by Christmas." It was a wildly optimistic prediction.

AKG LONDON

October 1950
U.S. Army paratroopers land in North Korea near the Chinese border in an offensive directed by Gen. Douglas MacArthur.

November 1950
South Korean military police escort a Chinese prisoner. The capture of such soldiers confirmed that the Chinese had entered the war.

HANK WALKER, TIMEPIX

FORCES IN KOREA

Participants	Forces	Combat Deaths
North Korea	260,000	214,899
China	2,300,000	401,401
TOTAL	**2,560,000**	**616,300**
United Nations Command		
Australia	2,282	304
Belgium	900	99
Canada	6,146	309
Colombia	1,068	140
Ethiopia	1,271	121
France	1,119	288
Greece	1,263	196
Netherlands	819	120
Luxembourg	44	2
New Zealand	1,389	31
Philippines	1,496	112
South Africa	826	20
South Korea	590,911	58,809
Thailand	1,294	129
Turkey	5,455	741
United Kingdom	14,198	722
United States	302,483	33,629
TOTAL	**932,964**	**95,772**

Figures vary according to sources

Medical assistance provided by Denmark, India, Italy, Norway, and Sweden

Design: Sally S. Summerall. Research: Kristine L. French, Patricia A. Healy. Edit: Maureen J. Flynn, Michael J. Horner, David B. Miller. GIS: Jan D. Morris, Wattanachai Todd Nirundorn, Windy A. Robertson. Production: John S. Ballay, Debbie J. Gibbons, Dianne C. Hunt. Text: Cliff Tarpy, author; Abigail A. Tipton, researcher. Relief by John A. Bonner

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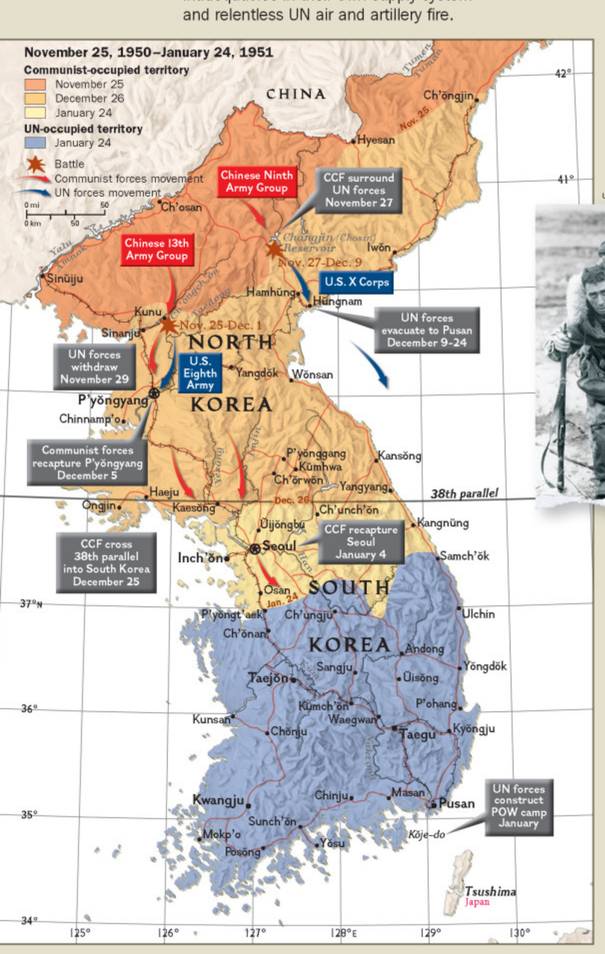
3 November 25, 1950—January 24, 1951
CHINA ON THE OFFENSIVE

The Chinese viewed the UN drive northward as a grave threat to the security of their country. By November 25 some 300,000 Chinese troops had entered the war in support of North Korea. In late December, after savage fighting in bitter winter weather, the last of the UN troops withdrew below the 38th parallel. On the last day of the year, North Korean and Chinese communist troops—more than half a million strong—mustered for a second invasion of South Korea. Though they penetrated well below the 38th parallel by late January, they were unable to sustain the offensive because of inadequacies in their own supply system—and relentless UN air and artillery fire.



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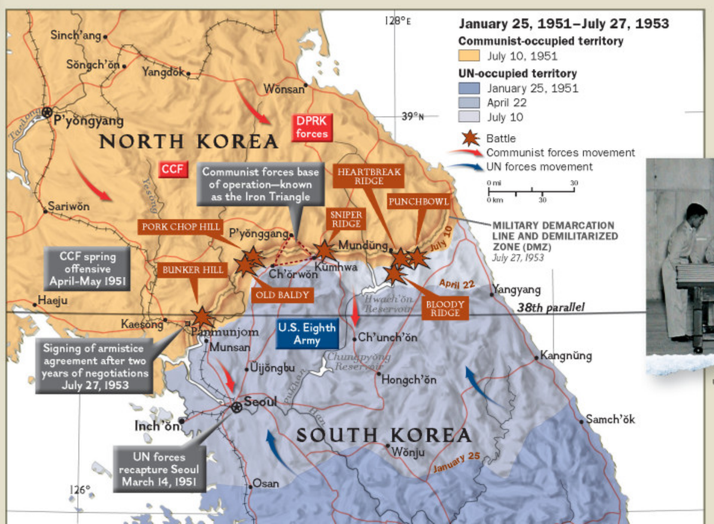
1951
A member of the Canadian battalion helps a wounded countryman to an aid station near the front line. Canada was among the 16 nations that sent combat troops to back up the South Koreans.

4 January 25, 1951—July 27, 1953
BACK TO SQUARE ONE

UN attacks forced communist troops north of the 38th parallel. MacArthur advocated driving the communists from the peninsula and expanding the war into China. President Harry Truman disagreed, promoting a policy of containment. MacArthur's public criticism of that policy caused him to be recalled from his command in April 1951. Truce talks began on July 10, but fighting continued during two years of negotiations. Reports of carnage came from such famous sites as Heartbreak Ridge, Bunker Hill, and Bloody Ridge. On July 27, 1953, representatives of the UN, North Korea, and China finally signed an armistice; South Korea never signed.

In all roughly 2.5 million Koreans were killed, wounded, or reported missing; over 33,000 Americans and some 3,000 other UN forces died, and an estimated 900,000 Chinese were killed or injured. After three years of war, the dividing line between the two sides ended up essentially where it began—along the 38th parallel.



July 27, 1953
Making history, U.S. Army Lt. Gen. William K. Harrison, Jr., seated at left, and Lt. Gen. Nam Il of the North Korean People's Army sign the armistice agreement at Panmunjom inside what would become the DMZ.

U.S. NATIONAL ARCHIVES

AFP PHOTO

September 2002
Parted by the DMZ, a brother from the North hugs his South Korean sister at a reunion for families separated by war.

Aftershocks
July 28, 1953—Present
ENTRENCHED DIVISION

The postwar years have brought less than perfect peace. Since the armistice was signed in 1953, some 1,400 people have died in clashes between the two Koreas near the DMZ. Most recently, six perished in a sea battle on June 29, 2002. Internal strife also bloodies the land. In 1980 in the South Korean city of Gwangju, government troops killed hundreds—perhaps thousands—of people protesting martial law. Today, growing numbers of Koreans want a thaw in relations and eventual reunification. But with Pyongyang reactivating its nuclear program and North Korean leader Kim Jong Il verbally threatening the U.S.—South Korea's ally—the world watches, fearful that regional tensions could turn into another deadly conflict.

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THE TWO KOREAS

"The Cold War was more frigid here than anywhere else in the world."
—Bruce Cumings, Korea historian

A thaw has begun as North and South Korea try new steps in their awkward diplomatic waltz. In 2000, after 47 years of uneasy truce, North Korean leader Kim Jong Il and South Korean President Kim Dae Jung convened an inter-Korean summit. They agreed to economic cooperation, cultural exchanges, and cross-border visits for relatives separated by the Demilitarized Zone (DMZ). These initiatives sprang from Kim Dae Jung's Sunshine Policy of engagement with the North, endorsed by his successor, President Roh Moo-hyun. Yet acrimony between North Korea and the United States—South Korea's strongest ally—complicates efforts for North-South reconciliation. And as anti-Americanism flares among South Koreans angered by a continued U.S. troop presence, President Roh struggles to balance his nation's 50-year U.S. alliance with hopes for a reunified Korea.

Produced by National Geographic Maps for National Geographic Magazine

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Washington, D.C., July 2003

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POPULATION

ONE PEOPLE SEVERED BY WAR

Descended from nomadic peoples out of northwest Asia, Koreans are among the most ethnically homogeneous populations in the world. They share an ancient history and a common geography—making their abrupt division after the Korean War all the more painful. At least two million family members are still separated by the DMZ. Despite steps toward opening that border, the two Koreas today stand worlds apart, with the highly insular North languishing as the South thrives. Since the war South Korea has swollen to 48 million people and shifted from 75 percent rural to 82 percent urban, with one in five people living in Seoul. Most Koreans, North or South, live along the peninsula's western lowlands, one of the world's most densely populated—and riven—landscapes.

Satellite images of the Korean peninsula at night show North Korea nearly devoid of light. The reason: a critical energy shortage that is crippling hopes of economic recovery. Generating only one-third the electricity it produced a decade ago, North Korea has turned to China for oil—giving China increasing leverage in the struggling nation.

North Korea has suffered nine straight years of food shortages due to bad weather, scarcity of fertilizer and farm equipment, and an ossified centralized economy. Some experts estimate that at least 2.5 million people have died of starvation or hunger-related diseases since 1994.

In February the first cross-border road in 50 years opened, easing the way for South Korean tourists to visit North Korea's Mount Kumgang resort area. Land mines have been cleared to make way for the reopening of two rail lines—closed since the end of the Korean War—that cross the DMZ.

The sea between Korea and Japan is called "East Sea" by Koreans and "Sea of Japan" by Japanese. National Geographic uses "Sea of Japan (East Sea)" when labeling the entire sea but gives precedence to East Sea here—within Korean territorial waters.

An area of frequent naval clashes, the Northern Limit Line—never officially recognized by North Korea—is a seaward extension of the Military Demarcation Line, de facto border between North and South.

The DMZ has provided an unforeseen benefit: sanctuary for two rare species of Asian cranes and other wildlife. Government and environmental groups hope to designate the DMZ and some adjacent lands in South Korea as a preserve.

North and South Korea together include more than 3,000 islands, most of them off the southern and western coasts. The largest, Jeju-do, covers 700 square miles and counts 548,000 residents.

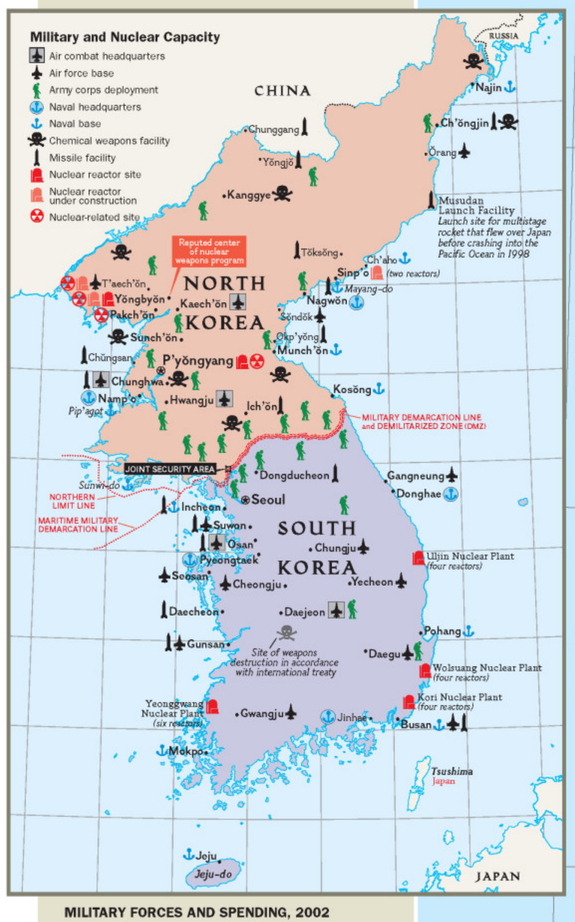
Japan and South Korea are already vulnerable to North Korea's arsenal of missiles, and some analysts believe that North Korea is developing a long-range missile that could reach the West Coast of the United States.

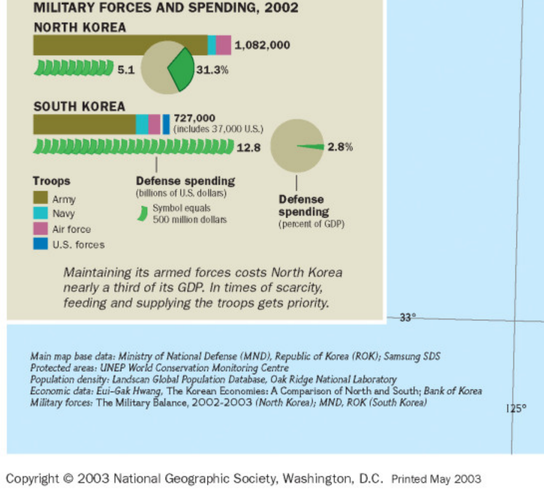
Exchanges of high-level diplomatic visits continue to improve relations between Japan and South Korea. But Japan's relations with North Korea remain extremely tense, hampered by a dispute over Japanese citizens abducted by North Korea during the Cold War.

ARMAMENTS

PENINSULA ON EDGE

A huge amount of weaponry and manpower crowds the border between the two Koreas. North Korea's military—fifth largest in the world—has one million troops, about 70 percent positioned within 60 miles of the DMZ. South Korea maintains 690,000 troops, bolstered by a U.S. force of 37,000. Tensions between the North and the U.S. soared last October when the U.S. presented evidence that North Korea had started a program to enrich uranium, which can be used in nuclear weapons. This effectively violated a 1994 pact in which North Korea pledged to abandon its nuclear program in exchange for energy assistance and oil. The U.S. immediately halted oil shipments. Soon thereafter North Korea expelled UN weapons inspectors and reopened its key nuclear facility at Yongbyon. In January it withdrew from the nuclear nonproliferation treaty, and in April North Korea claimed that it already possessed nuclear weapons. The crisis leaves South Korea in a diplomatically treacherous position, juggling its relations with the North and the U.S.—and vulnerable to the crossfire of any conflict.



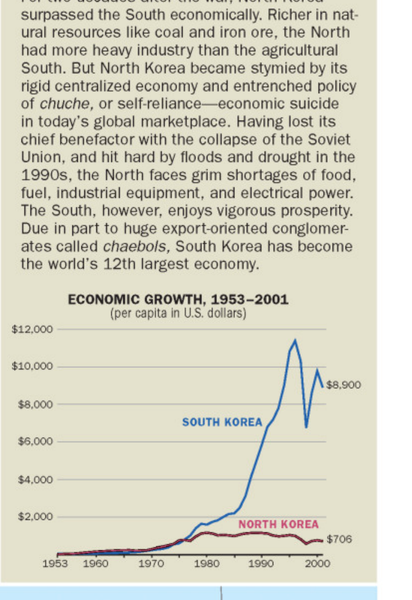


Maintaining its armed forces costs North Korea nearly a third of its GDP. In times of scarcity, feeding and supplying the troops gets priority.

ECONOMY

NORTHERN FREE FALL, SOUTHERN MIRACLE

For two decades after the war, North Korea surpassed the South economically. Richer in natural resources like coal and iron ore, the North had more heavy industry than the agricultural South. But North Korea became stymied by its rigid centralized economy and entrenched policy of *chuche*, or self-reliance—economic suicide in today's global marketplace. Having lost its chief benefactor with the collapse of the Soviet Union, and hit hard by floods and drought in the 1990s, the North faces grim shortages of food, fuel, industrial equipment, and electrical power. The South, however, enjoys vigorous prosperity. Due in part to huge export-oriented conglomerates called *chaebols*, South Korea has become the world's 12th largest economy.



Smaller in area, the South has more than twice the population of the North. About 80 percent of South Koreans were born after the Korean War.

In addition to the Korean peninsula, the Japanese archipelago, and the Chinese mainland, this map includes the Russian Far East, Taiwan, and the Philippines.

Map Legend
Limited-access highway
Other road
Ferry
High-speed railroad (due 2004)
Passenger railroad
International airport
Metropolitan, province capital
National capital
Point of interest

Height
feet / meters
9003 / 2744
0 / 0
-4921 / -1500
Depth

Polyconic Projection
SCALE 1:1,560,000
1 INCH = 24.6 MILES or 1 CENTIMETER = 15.6 KILOMETERS
STATUTE MILES 0 25 50
KILOMETERS 0 25 50

Geographic Equivalents

bong, pong, san	hill, mountain, peak
buk-do, bukto	northern province
do, shima	island(s)
dolmen	burial monument
ho, josuji	lake, reservoir
man	bay
nam-do, namdo	southern province
sanmaek	mountain range

NEW NAMES IN SOUTH KOREA
This map uses a new system for transcribing South Korean place-names from the Korean alphabet. This phonetic system, proclaimed by South Korea in 2000, changes places such as Cheju to Jeju and Pusan to Busan.

Main map base data: Ministry of National Defense (MND), Republic of Korea (ROK); Samsung SDS
Protected areas: UNEP World Conservation Monitoring Centre
Population density: Landscan Global Population Database, Oak Ridge National Laboratory
Economic data: Eui-Gak Hwang, The Korean Economies: A Comparison of North and South; Bank of Korea
Military forces: The Military Balance, 2002-2003 (North Korea); MND, ROK (South Korea)

Longitude East 127° of Greenwich

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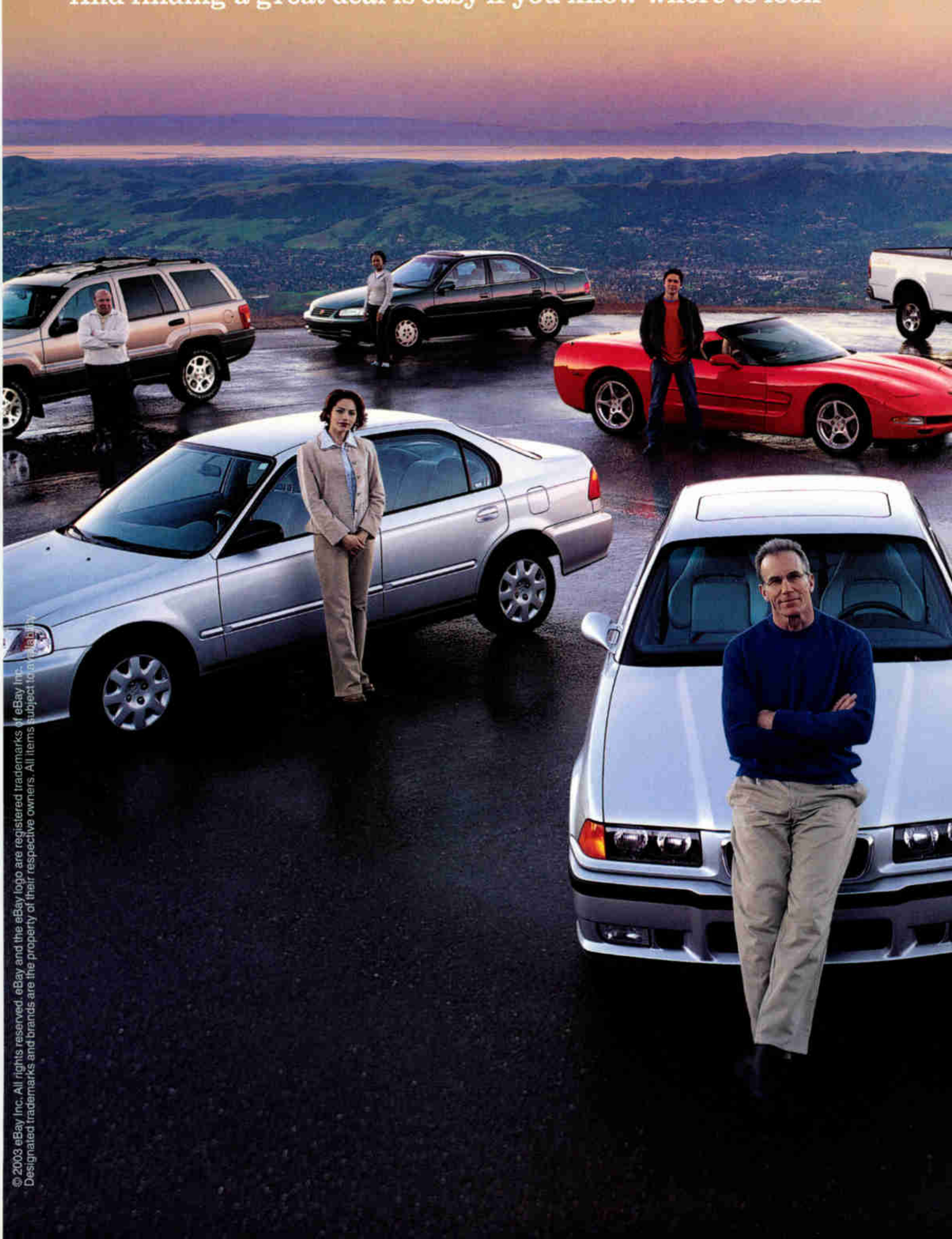

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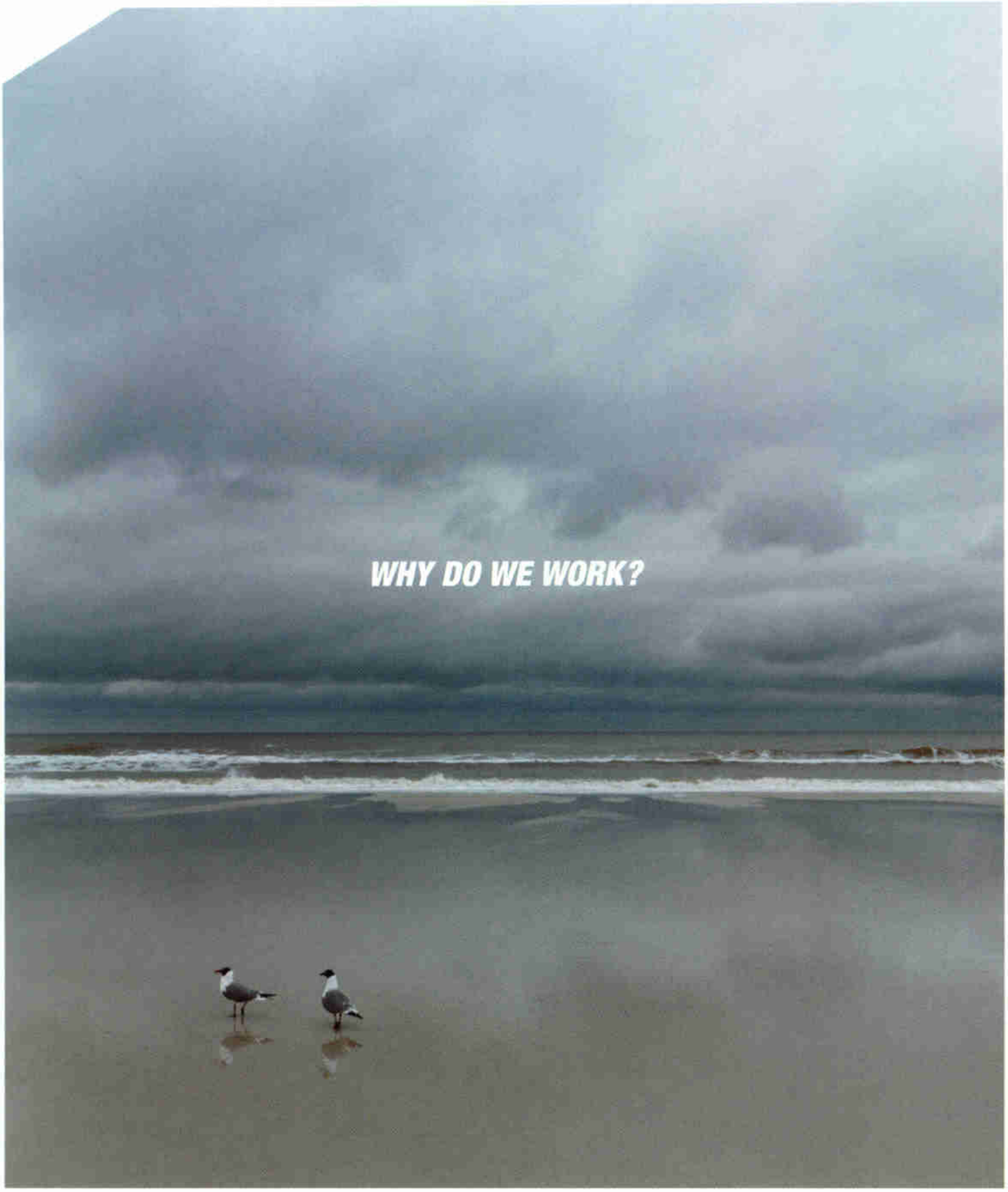

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VOL. 204 • NO. 1 • JULY 2003

Contents

Animal Attraction—28

FEATURES

DEPARTMENTS

THE COVER

It's another day on high alert, and another day of maneuvers for a camouflaged South Korean soldier near the DMZ.
BY MICHAEL YAMASHITA

Cover printed on recycled-content paper

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SIGHTS & SOUNDS Enter the waters of the Atlantic salmon.
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WEDNESDAYS, 8 P.M. ET/PT

Dangerous Jobs

They love their work: race car drivers who elude crashes at 200 miles an hour, test pilots who send Air Force fighter planes into frightening spins, maintenance crews who paint the spans of the Golden Gate Bridge (left). The new weekly series *Dangerous Jobs* profiles men and women, from firefighters to demolition specialists, who accept the threat of death as part of a day's work.

NATIONAL GEOGRAPHIC TODAY
WEEKDAYS, 7 P.M. ET/PT

Diary of the Planet

Catch nature's headline news—from eruptions in Indonesia (right) and earthquakes in China to panda births and new wilderness parks—on "Diary of the Planet," *National Geographic Today*'s daily roundup of breaking developments on restless Earth.

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JULY 13, 8 P.M. ET/PT

Geography of Wealth

For an African nomad, wealth means owning a few cattle. For Donald Trump, it means money—and lots of it—to acquire property. *Geography of Wealth* shows the many ways the world's people count their riches.

Channel and NGT&F programming information accurate at press time; consult local listings or the Society's website at nationalgeographic.com

NG Television and Film

NATIONAL GEOGRAPHIC ULTIMATE EXPLORER, MSNBC
SUNDAY, JUNE 29, 8 P.M. ET/PT

King Kong in My Pocket

In the wilds of Madagascar, *Ultimate Explorer* primatologist Mireya Mayor helps make a giant find: The tiny creature she holds is a new species of mouse lemur. Now Mireya returns to a forest coveted by loggers to search for more of them. It's the King Kong story with a twist—a human protecting a primate from assaults on its world.

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From the Editor

LINK HARPER

They call the Korean War the "Forgotten War," but I never forgot it. How could I? Fourteen years after the 1953 armistice, I was sent to Korea with the Second Infantry Division to serve along the Demilitarized Zone, or DMZ.

When GEOGRAPHIC began working on an article to mark the DMZ's 50th anniversary, I searched my basement for reminders of that time. I was surprised to find this faded photo of me at the fence line and my Imjin Scout badge (for 157 missions north of the Imjin River). The badge brought it all back: The tension. The cold. That brutal week in January '68 when the U.S.S. *Pueblo* was seized. Days earlier, 31 North Korean commandos bent on assassinating South Korea's president had sneaked across the DMZ and were spotted blocks from his residence in Seoul. Night merged into day as our patrols hunted them as they fled for the border, the flickering light of flares illuminating the darkness. In the end, one commando was captured, the rest killed.

This month's cover story shows that not much has changed. The fence line's still there. The stare-downs still happen. And I still feel the bond between men who suffer winter nights and wade through summer mud. But there's one big difference: These days, with the prospect of a nuclear North Korea, the stakes are even higher.

Bill Allen

■ Watch my preview of the August issue on ***National Geographic Today*** on July 17 at 7 p.m. and again at 10 p.m. (ET and PT) on the National Geographic Channel.

NATIONAL GEOGRAPHIC

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Please read the important Product Information about NEXIUM on the following page and discuss it with your doctor.

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Nexium®
(esomeprazole magnesium)

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No advertisement can provide all the information needed to prescribe a drug. This advertisement does not take the place of careful discussions with your doctor. *Only your doctor* has the training to weigh the risks and benefits of a prescription drug for you.

Nexium® *(esomeprazole magnesium)*

20-MG, 40-MG Delayed-Release Capsules

BRIEF SUMMARY Before prescribing NEXIUM, please see full Prescribing Information. **INDICATIONS AND USAGE** NEXIUM is indicated for the short-term treatment (4 to 8 weeks) in the healing and symptomatic resolution of diagnostically confirmed erosive esophagitis. **CONTRAINDICATIONS** NEXIUM is contraindicated in patients with known hypersensitivity to any component of the formulation or to substituted benzimidazoles. **PRECAUTIONS** Symptomatic response to therapy with NEXIUM does not preclude the presence of gastric malignancy. Atrophic gastritis has been noted occasionally in gastric corpus biopsies from patients treated long-term with omeprazole, of which NEXIUM is an enantiomer. **Information for Patients:** NEXIUM Delayed-Release Capsules should be taken at least one hour before meals. For patients who have difficulty swallowing capsules, one tablespoon of applesauce can be added to an empty bowl and the NEXIUM Delayed-Release Capsule opened, and the pellets carefully emptied onto the applesauce. The pellets should be mixed with the applesauce and then swallowed immediately. The applesauce used should not be hot and should be soft enough to be swallowed without chewing. The pellets should not be chewed or crushed. The pellet/applesauce mixture should not be stored for future use. Antacids may be used while taking NEXIUM. **Drug Interactions:** Esomeprazole is extensively metabolized in the liver by CYP2C19 and CYP3A4. *In vitro* and *in vivo* studies have shown that esomeprazole is not likely to inhibit CYPs 1A2, 2A6, 2C9, 2D6, 2E1 and 3A4. No clinically relevant interactions with drugs metabolized by these CYP enzymes would be expected. Drug interaction studies have shown that esomeprazole does not have any clinically significant interactions with phenytoin, warfarin, quinidine, clarithromycin or amoxicillin. Esomeprazole may potentially interfere with CYP2C19, the major esomeprazole metabolizing enzyme. Coadministration of esomeprazole 30 mg and diazepam, a CYP2C19 substrate, resulted in a 45% decrease in clearance of diazepam. Increased plasma levels of diazepam were observed 12 hours after dosing and onwards. However, at that time, the plasma levels of diazepam were below the therapeutic interval, and thus this interaction is unlikely to be of clinical relevance. Esomeprazole inhibits gastric acid secretion. Therefore, esomeprazole may interfere with the absorption of drugs where gastric pH is an important determinant of bioavailability (eg, ketoconazole, iron salts and digoxin). Coadministration of oral contraceptives, diazepam, phenytoin, or quinidine did not seem to change the pharmacokinetic profile of esomeprazole. **Carcinogenesis, Mutagenesis, Impairment of Fertility:** The carcinogenic potential of esomeprazole was assessed using omeprazole studies. In two 24-month oral carcinogenicity studies in rats, omeprazole at daily doses of 1.7, 3.4, 13.8, 44.0 and 140.8 mg/kg/day (about 0.7 to 57 times the human dose of 20 mg/day expressed on a body surface area basis) produced gastric ECL cell carcinoids in a dose-related manner in both male and female rats; the incidence of this effect was markedly higher in female rats, which had higher blood levels of omeprazole. Gastric carcinoids seldom occur in the untreated rat. In addition, ECL cell hyperplasia was present in all treated groups of both sexes. In one of these studies, female rats were treated with 13.8 mg omeprazole/kg/day (about 5.6 times the human dose on a body surface area basis) for 1 year, then followed for an additional year without the drug. No carcinoids were seen in these rats. An increased incidence of treatment-related ECL cell hyperplasia was observed at the end of 1 year (94% treated vs 10% controls). By the second year the difference between treated and control rats was much smaller (46% vs 26%) but still showed more hyperplasia in the treated group. Gastric adenocarcinoma was seen in one rat (2%). No similar tumor was seen in male or female rats treated for 2 years. For this strain of rat no similar tumor has been noted historically, but a finding involving only one tumor is difficult to interpret. A 78-week mouse carcinogenicity study of omeprazole did not show increased tumor occurrence, but the study was not conclusive. Esomeprazole was negative in the Ames mutation test, in the *in vivo* rat bone marrow cell chromosome aberration test, and the *in vivo* mouse micronucleus test. Esomeprazole, however, was positive in the *in vitro* human lymphocyte chromosome aberration test. Omeprazole was positive in the *in vitro* human lymphocyte chromosome aberration test, the *in vivo* mouse bone marrow cell chromosome aberration test, and the *in vivo* mouse micronucleus test. The potential effects of esomeprazole on fertility and reproductive performance were assessed using omeprazole studies. Omeprazole at oral doses up to 138 mg/kg/day in rats (about 56 times the human dose on a body surface area basis) was found to have no effect on reproductive performance of parental animals. **Pregnancy:** *Teratogenic Effects. Pregnancy Category B*—Teratology studies have been performed in rats at oral doses up to 280 mg/kg/day (about 57 times the human dose on a body surface area basis) and in rabbits at oral doses up to 86 mg/kg/day (about 35 times the human dose on a body surface area basis) and have revealed no evidence of impaired fertility or harm to the fetus due to esomeprazole. There are, however, no adequate and well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of human response, this drug should be used during pregnancy only if clearly needed. Teratology studies conducted with omeprazole in rats at oral doses up to 138 mg/kg/day (about 56 times the human dose on a body surface area basis) and in rabbits at doses up to 69 mg/kg/day (about 56 times the human dose on a body surface area basis) did not disclose any evidence for a teratogenic potential of omeprazole. In rabbits, omeprazole in a dose range of 6.9 to 69.1 mg/kg/day (about 5.5 to 56 times the human dose on a body surface area basis) produced dose-related increases in embryolethality, fetal resorptions, and pregnancy disruptions. In rats, dose-related embryo/fetal toxicity and postnatal developmental toxicity were observed in offspring resulting from parents treated with omeprazole at 13.8 to 138.0 mg/kg/day (about 5.6 to 56 times the human doses on a body surface area basis). There are no adequate and well-controlled studies in pregnant women. Sporadic reports have been received of congenital abnormalities occurring in infants born to women who have received omeprazole during pregnancy. **Nursing Mothers:** The excretion of esomeprazole in milk has not been studied. However, omeprazole concentrations have been measured in breast milk of a woman following oral administration of 20 mg. Because esomeprazole is likely to be excreted in human milk, because of the potential for serious adverse reactions in nursing infants from esomeprazole, and because of the potential for tumorigenicity shown for omeprazole in rat carcinogenicity studies, a decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the mother. **Pediatric Use:** Safety and effectiveness in pediatric patients have not been established. **Geriatric Use:** Of the total number of patients who received NEXIUM in clinical trials, 778 were 65 to 74 years of age and 124 patients were ≥ 75 years of age. No overall differences in safety and efficacy were observed between the elderly and younger individuals, and other reported clinical experience has not identified differences in responses between the elderly and younger patients, but greater sensitivity of some older individuals cannot be ruled out. **ADVERSE REACTIONS** The safety of NEXIUM was evaluated in over 10,000 patients (aged 18-84 years) in clinical trials worldwide including over 7,400 patients in the United States and over 2,600 patients in Europe and Canada. Over 2,900 patients were treated in long-term studies for up to 6-12 months. In general, NEXIUM was well tolerated in both short- and long-term clinical trials. The safety in the treatment of healing of erosive esophagitis was assessed in four randomized comparative clinical trials, which included 1,240 patients on NEXIUM 20 mg, 2,434 patients on NEXIUM 40 mg, and 3,008 patients on omeprazole 20 mg daily. The most frequently occurring adverse events (≥1%) in all three groups was headache (5.5, 5.0, and 3.8, respectively) and diarrhea (no difference among the three groups). Nausea, flatulence, abdominal pain, constipation, and dry mouth occurred at similar rates among patients taking NEXIUM or omeprazole. Additional adverse events that were reported as possibly or probably related to NEXIUM with an incidence < 1% are listed below by body system: ***Body as a Whole:*** abdomen enlarged, allergic reaction, asthenia, back pain, chest pain, chest pain substernal, facial edema, peripheral edema, hot flushes, fatigue, fever, flu-like disorder, generalized edema, leg edema, malaise, pain, rigors; ***Cardiovascular:*** flushing, hypertension, tachycardia; ***Endocrine:*** goiter; ***Gastrointestinal:*** bowel irregularity, constipation aggravated, dyspepsia, dysphagia, dysplasia GI, epigastric pain, eructation, esophageal disorder, frequent stools, gastroenteritis, GI hemorrhage, GI symptoms not otherwise specified, hiccup, melena, mouth disorder, pharynx disorder, rectal disorder, serum gastrin increased, tongue disorder, tongue edema, ulcerative stomatitis, vomiting; ***Hearing:*** earache, tinnitus; ***Hematologic:*** anemia, anemia hypochromic, cervical lymphoadenopathy, epistaxis, leukocytosis, leukopenia, thrombocytopenia; ***Hepatic:*** bilirubinemia, hepatic function abnormal, SGOT increased, SGPT increased; ***Metabolic/Nutritional:*** glycosuria, hyperuricemia, hyponatremia, increased alkaline phosphatase, thirst, vitamin B12 deficiency, weight increase, weight decrease; ***Musculoskeletal:*** arthralgia, arthritis aggravated, arthropathy, cramps, fibromyalgia syndrome, hernia, polymyalgia rheumatica; ***Nervous System/Psychiatric:*** anorexia, apathy, appetite increased, confusion, depression aggravated, dizziness, hypertonia, nervousness, hypoesthesia, impotence, insomnia, migraine, migraine aggravated, paresthesia, sleep disorder, somnolence, tremor, vertigo, visual field defect; ***Reproductive:*** dysmenorrhea, menstrual disorder, vaginitis; ***Respiratory:*** asthma aggravated, coughing, dyspnea, larynx edema, pharyngitis, rhinitis, sinusitis; ***Skin and Appendages:*** acne, angioedema, dermatitis, pruritus, pruritus ani, rash, rash erythematous, rash maculo-papular, skin inflammation, sweating increased, urticaria; ***Special Senses:*** otitis media, parosmia, taste loss, taste perversion; ***Urogenital:*** abnormal urine, albuminuria, cystitis, dysuria, fungal infection, hematuria, micturition frequency, moniliasis, genital moniliasis, polyuria; ***Visual:*** conjunctivitis, vision abnormal. Endoscopic findings that were reported as adverse events include: duodenitis, esophagitis, esophageal stricture, esophageal ulceration, esophageal varices, gastric ulcer, gastritis, hernia, benign polyps or nodules, Barrett's esophagus, and mucosal discoloration. Postmarketing Reports – There have been spontaneous reports of adverse events with postmarketing use of esomeprazole. These reports have included rare cases of anaphylactic reaction. Other adverse events not observed with NEXIUM, but occurring with omeprazole can be found in the omeprazole package insert, **ADVERSE REACTIONS** section. **OVERDOSAGE** A single oral dose of esomeprazole at 510 mg/kg (about 103 times the human dose on a body surface area basis), was lethal to rats. The major signs of acute toxicity were reduced motor activity, changes in respiratory frequency, tremor, ataxia, and intermittent clonic convulsions. There have been no reports of overdose with esomeprazole. Reports have been received of overdosage with omeprazole in humans. Doses ranged up to 2,400 mg (120 times the usual recommended clinical dose). Manifestations were variable, but included confusion, drowsiness, blurred vision, tachycardia, nausea, diaphoresis, flushing, headache, dry mouth, and other adverse reactions similar to those seen in normal clinical experience (see omeprazole package insert-**ADVERSE REACTIONS**). No specific antidote for esomeprazole is known. Since esomeprazole is extensively protein bound, it is not expected to be removed by dialysis. In the event of overdosage, treatment should be symptomatic and supportive. As with the management of any overdose, the possibility of multiple drug ingestion should be considered. For current information on treatment of any drug overdose, a certified Regional Poison Control Center should be contacted. Telephone numbers are listed in the Physicians' Desk Reference (PDR) or local telephone book.

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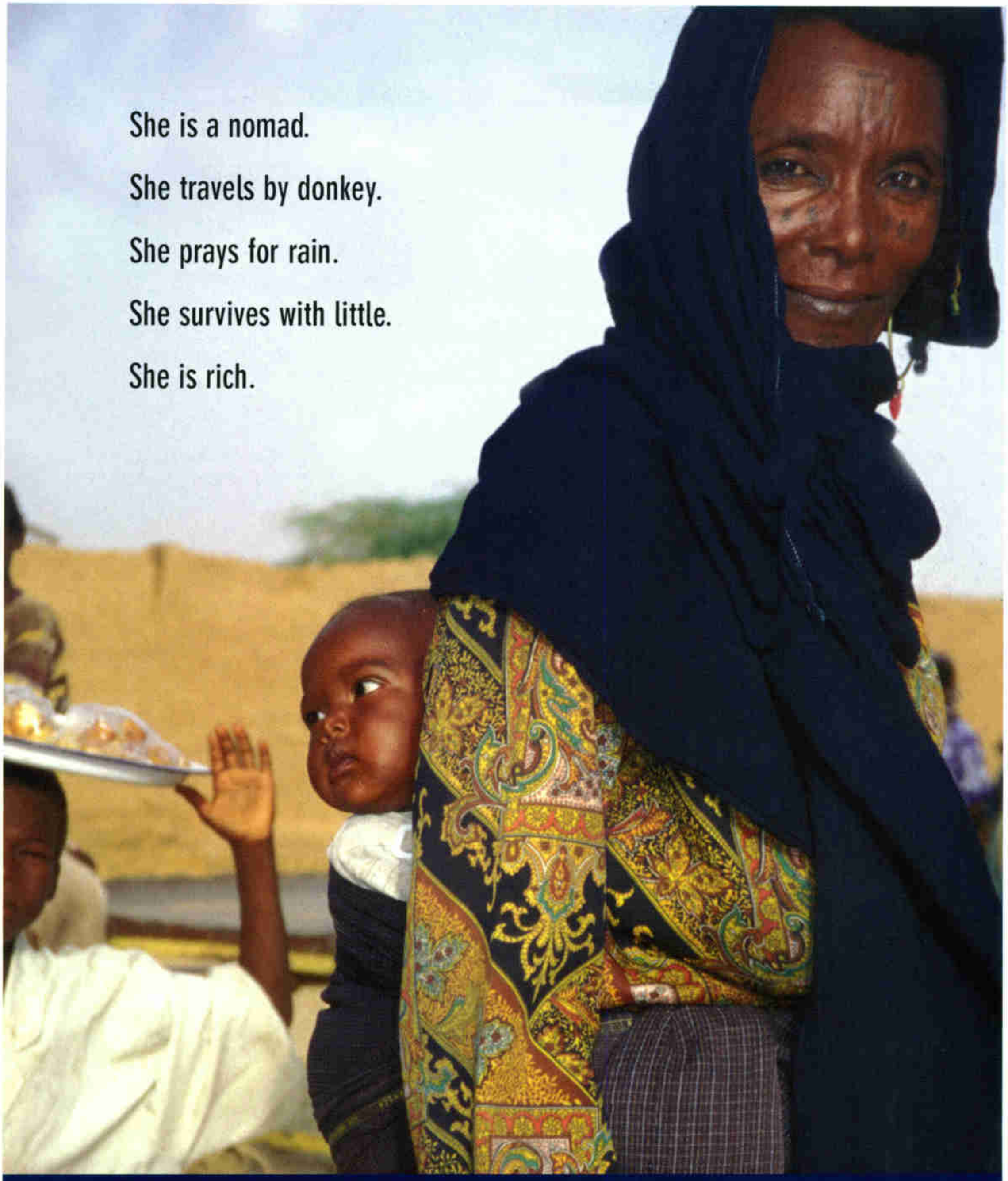

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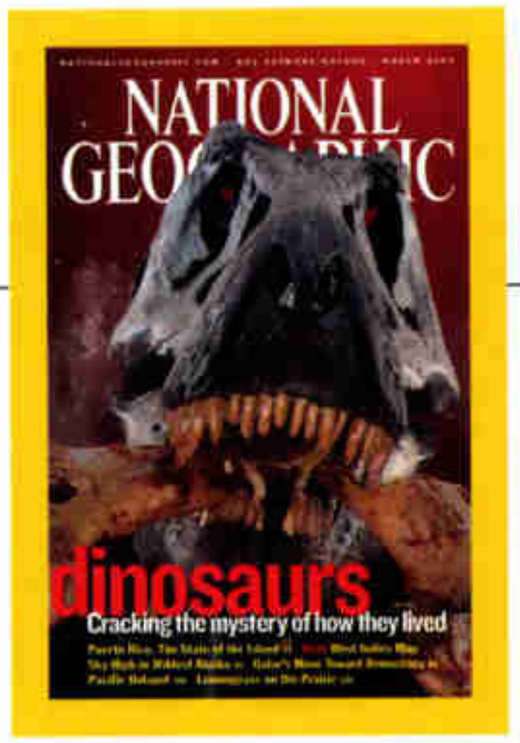

March 2003

Writer Andrew Cockburn has said that politics is a national sport in Puerto Rico, and we have the mail to prove it. A month after publication, his article had generated letters from nearly 800 readers—most of them angered by what they see as a distorted portrayal of Puerto Rico. Opinions also flared in more than 3,800 postings on our online forum (nationalgeographic.com/ngm/0303), *a new record.*

Puerto Rico

By concentrating on interviews with people who favor independence, you did a disservice to 95 percent of the population, who favor either the current status or statehood. Puerto Ricans pay social security and medicare as do taxpayers on the mainland. Puerto Ricans have joined the U.S. military in every conflict since WWI. A Puerto Rican was the pilot in the only plane shot down during the attack on Libya in 1986. During his burial service his mother said she was very proud that her son had given his life for our country.

DAVID PLACERES
Orlando, Florida

Was the article created in revenge for some bad experience on the island—a mugging or a loss of equipment? Andrew Cockburn and Amy Toensing manage to make Puerto Rico look like the hellhole of the Caribbean. Maybe the next time they visit, they should leave the slums and tour the island. I did, and managed to find a lot of beautiful places.

LOUIS REVERON
Tall Timber, Maryland

It was obvious to me that there was an intent to portray only the grotesque and the obscure. Why were Puerto Rican professionals and their work places, houses, and families not featured? Why weren't average middle-class families profiled? There are drugs and lost souls in every society. I wonder how Texans would react if the "Lone Star Republic" was portrayed with photos of the Ku Klux Klan, Enron executives, and people shooting up in Houston's fifth ward?

RAMÓN BERROCAL
San Juan, Puerto Rico

How does a state withdraw from the Union and become a commonwealth? I nominate my home state, Ohio. Puerto Ricans pay no federal income taxes, yet get the privileges of citizenship and seemingly unlimited welfare without verification of income—that's what I want for everyone in Ohio. I gladly will give up our votes in Congress.

GARY HRUSCH
North Ridgeville, Ohio

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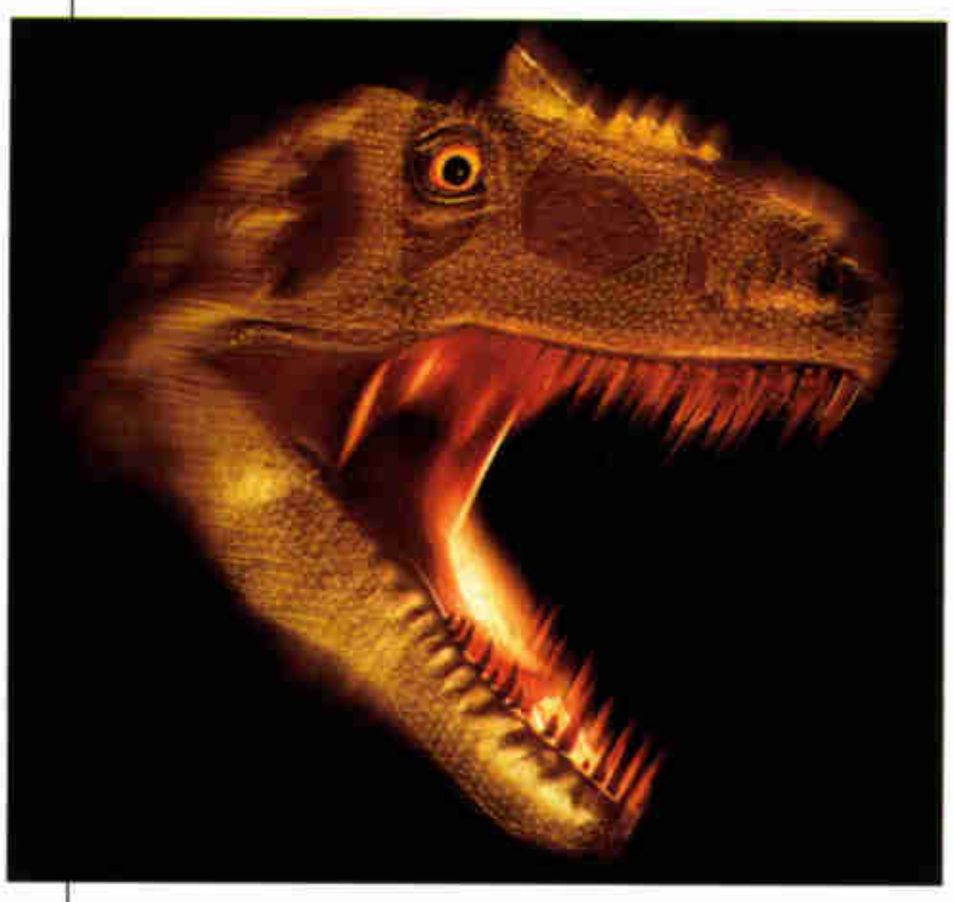
Dinosaurs

Please assure Jack Horner that he has at least one supporter for his hypothesis that *T. rex* was a scavenger, not a predator.



Over 50 years ago I offered the same hypothesis in an undergraduate paper based on the observation that modern predators such as lions have large, strong forelimbs and paws with which to catch and bring down prey. By contrast, *T. rex*'s forelimbs were inadequate to do the job. I was upbraided for questioning the truth as revealed by my betters. Is it possible that my professor is still among those who have failed to be persuaded by Horner?

H. W. PETERSEN
Bellevue, Washington

When the coal mine shut down a few years ago, we lost the security that it provided the many track sites near Grande Cache, Alberta. Since then we have been trying to get protective status for these sites, which are susceptible to vandalism, theft, and industrial activity. The wonderful photograph on pages 30-31 has raised the awareness of these sites as paleontological resources that need to be preserved, and will go a long way in helping to achieve this goal.

RICH MCCREA
University of Alberta
Edmonton, Alberta

I was pleased to participate in the dinosaur article by using colored balls to illustrate the heart sizes of *Argentinosaurus* with a fully elevated head. However, I wish to point out that the calculations of heart size were based on a paper published by Roger Seymour and Harvey Lillywhite in 2000. The essential contribution of these scientists should have been noted in the caption.

DENNIS L. CLAUSSEN
Miami University
Oxford, Ohio

Those who feel offended by the article should examine the facts before insulting the writer of this piece. We, the people of Puerto Rico, are our own worst enemy when we refuse to acknowledge the truth about our situation. Corrupt politicians, a mediocre public school system, a paternalistic welfare government, and an economic system that milks the middle class to feed both the poor and the wealthy are all a part of a problem that we've created ourselves. With a 19 percent teen pregnancy rate and a murder rate that is more than three times as great as that of the U.S., we need to take a good long look at ourselves and stop being such cry babies. One of the worst legacies of colonialism is the victim mentality that it generates. As for Puerto Rico's future, the only way to make it better is to assume responsibility for ourselves and stop blaming others for our problems.

ROBERT GUZMAN
Moca, Puerto Rico
FROM OUR ONLINE FORUM
nationalgeographic.com/ngm/0303

Although it may be true that 60 percent of Puerto Ricans qualify for public assistance, the article excluded some important information. Because salaries in Puerto Rico are extremely low—and the cost of goods is higher than in the United States—many people with jobs still qualify for public assistance.

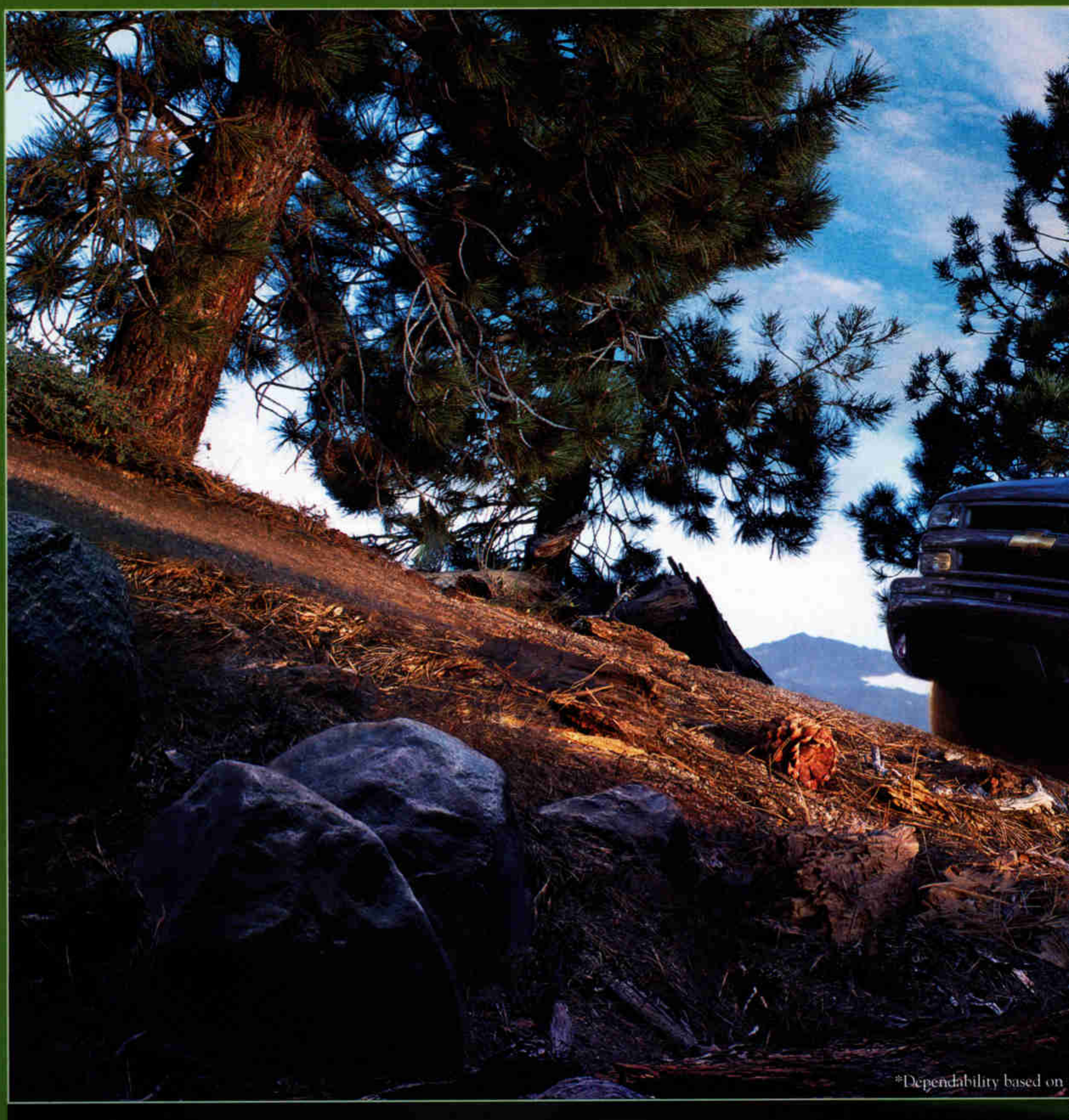
EDWIN RIVAS
Putnam Valley, New York

I am a military spouse stationed with my husband at Naval Station Roosevelt Roads in Puerto Rico. I have lived here for two years and have enjoyed myself immensely. In your article, interviewee Luis Ramos describes the island of Vieques as a "combat zone." The truth is that the bombing range is used only a few times each year for a couple of weeks. Mr. Cockburn fails to mention the miles of fence line that have been destroyed during the "peaceful protests," the broken glass and rocks thrown at the military police, and the thousands of dollars wasted when military exercises get delayed. He also fails to

WRITE TO FORUM

National Geographic Magazine, PO Box 98199, Washington, DC 20090-8199, or by fax to **202-828-5460**, or via the Internet to **ngsforum@nationalgeographic.com**. Include name, address, *and daytime telephone. Letters may be* edited for clarity and length.

YOU'VE HEARD OF MOUNTAIN LIONS RUNNING LOOSE



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mention the jobs provided by the military and the funding given to residents to boost their economic opportunities.

CARRIE FORRESTER
Ceiba, Puerto Rico

West Indies Map

I found your map of the West Indies fascinating. I noticed a small U.S.-held island just west of Haiti called Navassa. How did it become a part of the U.S. and does anyone reside there?

BRIAN DOWLING
Troy, Michigan

Navassa became a U.S. territory because of bird droppings. The Guano Islands Act of 1856 sanctioned U.S. citizens to take possession of any unclaimed, uninhabited island in the world that contained guano. A representative of a Baltimore fertilizer company claimed Navassa for guano mining in 1857. When African-American laborers rebelled against horrific working conditions in 1889, five white supervisors were killed. A Baltimore trial handed down death sentences, but petitions from the black community swayed President Benjamin Harrison to commute the sentences to jail time. Guano operations ended in 1898. The uninhabited rocky island is now a national wildlife refuge open only to researchers.

Qatar

Of course the young men of Qatar have a right to their opinion about the greatness of Osama bin Laden, but isn't it a bit hypocritical to praise the man while drinking Starbucks coffee? If he had his way, they would not have the freedom to drink American coffee or eat American food or attend American universities. And to be certain, the young women wearing "stunning, stylish outfits" under their *abayas* would not have the freedom to study fashion at the university. They would not even have the freedom to learn to read.

The young women wearing "stunning, stylish outfits" under their *abayas* would not have the freedom to study fashion at the university. They would not even have the freedom to learn to read.

KATHLEEN TAKACH
Tallahassee, Florida

Wrangell-St. Elias National Park

My husband proposed to me atop a mountain pass in Wrangell-St. Elias National Park. I remember the sublime view of Mount Wrangell standing behind us and the Chugach range sprawled out before us. Thanks so much to John Mitchell for bringing back those memories and to Frans Lanting for the absolutely breathtaking photographs.

LISA HATFIELD
Portland, Oregon

You made me proud of just being on a planet with places like Wrangell-St. Elias National Park—proud, and ready with renewed determination to do my small part to protect the precious planet we all share as home.

JANETHA B. BOSWELL
Fort Collins, Colorado

Behind the Scenes

Why does it not surprise me that France is one of the countries in which the D-Day cover of the June 2002 NATIONAL GEOGRAPHIC was not used? I can understand Germany and perhaps Poland, but France? The decision by your French editor not to use the cover honoring those who fought and died at Normandy is a disgrace to your fine magazine and dishonors the thousands of American dead who repose in cemeteries there.

BRENT F. MOODY
Phoenix, Arizona

How ironic that the French would put a woman's butt on their cover rather than the flag of the country that saved their butt on D-Day.

SANDY BUCKNER
Cumberland Furnace, Tennessee

NGM-France editor François Marot felt that the cover on "Marriages in France" would outsell the D-Day cover on the newsstand—an important consideration because, unlike in the U.S., most of NGM-France's circulation comes from the newsstand. Our local-language editions occasionally create articles of specific interest to their region; the marriage cover was timed to coincide with June, a traditional month for weddings in France. The D-Day story remained in the issue and is among the most popular stories to run since the edition's debut in 1999, buttressing Marot's view that "the French are still very grateful for America's role in World War II."

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ONCE-A-DAY

ARICEPT® (donepezil HCl) 5-MG AND 10-MG TABLETS

STRENGTH IN THE FACE OF ALZHEIMER'S™

ARICEPT® (Donepezil Hydrochloride Tablets)

Brief Summary—see package insert for full prescribing information. **INDICATIONS AND USAGE** ARICEPT® is indicated for the treatment of mild to moderate dementia of the Alzheimer's type. **CONTRAINDICATIONS** ARICEPT® is contraindicated in patients with known hypersensitivity to donepezil hydrochloride or to piperidine derivatives. **WARNINGS** ***Anesthesia:*** ARICEPT®, as a cholinesterase inhibitor, is likely to exaggerate succinylcholine-type muscle relaxation during anesthesia. ***Cardiovascular Conditions:*** Because of their pharmacological action, cholinesterase inhibitors may have vagotonic effects on the sinoatrial and atrioventricular nodes. This effect may manifest as bradycardia or heart block in patients both with and without known underlying cardiac conduction abnormalities. Syncopal episodes have been reported in association with the use of ARICEPT®. ***Gastrointestinal Conditions:*** Through their primary action, cholinesterase inhibitors may be expected to increase gastric acid secretion due to increased cholinergic activity. Therefore, patients should be monitored closely for symptoms of active or occult gastrointestinal bleeding, especially those at increased risk for developing ulcers, e.g., those with a history of ulcer disease or those receiving concurrent nonsteroidal anti-inflammatory drugs (NSAIDS). Clinical studies of ARICEPT® have shown no increase, relative to placebo, in the incidence of either peptic ulcer disease or gastrointestinal bleeding. ARICEPT®, as a predictable consequence of its pharmacological properties, has been shown to produce diarrhea, nausea and vomiting. These effects, when they occur, appear more frequently with the 10 mg/day dose than with the 5 mg/day dose. In most cases, these effects have been mild and transient, sometimes lasting one to three weeks, and have resolved during continued use of ARICEPT®. ***Genitourinary:*** Although not observed in clinical trials of ARICEPT®, cholinomimetics may cause bladder outflow obstruction. ***Neurological Conditions:*** Seizures: Cholinomimetics are believed to have some potential to cause generalized convulsions. However, seizure activity also may be a manifestation of Alzheimer's Disease. ***Pulmonary Conditions:*** Because of their cholinomimetic actions, cholinesterase inhibitors should be prescribed with care to patients with a history of asthma or obstructive pulmonary disease. **PRECAUTIONS Drug-Drug Interactions** ***Drugs Highly Bound to Plasma Proteins:*** Drug displacement studies have been performed *in vitro* between this highly bound drug (96%) and other drugs such as furosemide, digoxin, and warfarin. ARICEPT® at concentrations of 0.3-10 µg/mL did not affect the binding of furosemide (5 µg/mL), digoxin (2 ng/mL), and warfarin (3 µg/mL) to human albumin. Similarly, the binding of ARICEPT® to human albumin was not affected by furosemide, digoxin, and warfarin. ***Effect of ARICEPT® on the Metabolism of Other Drugs:*** No *in vivo* clinical trials have investigated the effect of ARICEPT® on the clearance of drugs metabolized by CYP 3A4 (e.g. cisapride, terfenadine) or by CYP 2D6 (e.g. imipramine). However, *in vitro* studies show a low rate of binding to these enzymes (mean K_i about 50–130 µM), that, given the therapeutic plasma concentrations of donepezil (164 nM), indicates little likelihood of interference. Whether ARICEPT® has any potential for enzyme induction is not known. ***Effect of Other Drugs on the Metabolism of ARICEPT®:*** Ketoconazole and quinidine, inhibitors of CYP450, 3A4 and 2D6, respectively, inhibit donepezil metabolism *in vitro*. Whether there is a clinical effect of these inhibitors is not known. Inducers of CYP 2D6 and CYP 3A4 (e.g., phenytoin, carbamazepine, dexamethasone, rifampin, and phenobarbital) could increase the rate of elimination of ARICEPT®. ***Use with Anticholinergics:*** Because of their mechanism of action, cholinesterase inhibitors have the potential to interfere with the activity of anticholinergic medications. ***Use with Cholinomimetics and Other Cholinesterase Inhibitors:*** A synergistic effect may be expected when cholinesterase inhibitors are given concurrently with succinylcholine, similar neuromuscular blocking agents or cholinergic agonists such as bethanechol. **Carcinogenesis, Mutagenesis, Impairment of Fertility** Carcinogenicity studies of donepezil have not been completed. Donepezil was not mutagenic in the Ames reverse mutation assay in bacteria. In the chromosome aberration test in cultures of Chinese hamster lung (CHL) cells, some clastogenic effects were observed. Donepezil was not clastogenic in the *in vivo* mouse micronucleus test. Donepezil had no effect on fertility in rats at doses up to 10 mg/kg/day (approximately 8 times the maximum recommended human dose on a mg/m² basis). **Pregnancy** ***Pregnancy Category C:*** Teratology studies conducted in pregnant rats at doses up to 16 mg/kg/day (approximately 13 times the maximum recommended human dose on a mg/m² basis) and in pregnant rabbits at doses up to 10 mg/kg/day (approximately 16 times the maximum recommended human dose on a mg/m² basis) did not disclose any evidence for a teratogenic potential of donepezil. However, in a study in which pregnant rats were given up to 10 mg/kg/day (approximately 8 times the maximum recommended human dose on a mg/m² basis) from day 17 of gestation through day 20 postpartum, there was a slight increase in still births and a slight decrease in pup survival through day 4 postpartum at this dose, the next lower dose tested was 3 mg/kg/day. There are no adequate or well-controlled studies in pregnant women. ARICEPT® should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus. **Nursing Mothers** It is not known whether donepezil is excreted in human breast milk. ARICEPT® has no indication for use in nursing mothers. **Pediatric Use** There are no adequate and well-controlled trials to document the safety and efficacy of ARICEPT® in any illness occurring in children. **ADVERSE REACTIONS Adverse Events Leading to Discontinuation** The rates of discontinuation from controlled clinical trials of ARICEPT® due to adverse events for the ARICEPT® 5 mg/day treatment groups were comparable to those of placebo-treatment groups at approximately 5%. The rate of discontinuation of patients who received 7-day escalations from 5 mg/day to 10 mg/day, was higher at 13%. The most common adverse events leading to discontinuation, defined as those occurring in at least 2% of patients and at twice the incidence seen in placebo patients, are shown in Table 1.

Table 1. Most Frequent Adverse Events Leading to Withdrawal from Controlled Clinical Trials by Dose Group

Dose Group	Placebo	5 mg/day ARICEPT®	10 mg/day ARICEPT®
Patients Randomized	355	350	315
Event/%Discontinuing			
Nausea	1%	1%	3%
Diarrhea	0%	<1%	3%
Vomiting	<1%	<1%	2%

Most Frequent Adverse Clinical Events Seen in Association with the Use of ARICEPT® The most common adverse events, defined as those occurring at a frequency of at least 5% in patients receiving 10 mg/day and twice the placebo rate, are largely predicted by ARICEPT®'s cholinomimetic effects. These include nausea, diarrhea, insomnia, vomiting, muscle cramp, fatigue and anorexia. These adverse events were often of mild intensity and transient, resolving during continued ARICEPT® treatment without the need for dose modification. There is evidence to suggest that the frequency of these common adverse events may be affected by the rate of titration. An open-label study was conducted with 269 patients who received placebo in the 15- and 30-week studies. These patients were titrated to a dose of 10 mg/day over a 6-week period. The rates of common adverse events were lower than those seen in patients titrated to 10 mg/day over one week in the controlled clinical trials and were comparable to those seen in patients on 5 mg/day. See Table 2 for a comparison of the most common adverse events following one and six week titration regimens.

Table 2. Comparison of Rates of Adverse Events in Patients Titrated to 10 mg/day Over 1 and 6 Weeks

	No titration		One-week titration	Six-week titration
Adverse Event	**Placebo (n=315)**	**5 mg/day (n=311)**	**10 mg/day (n=315)**	**10 mg/day (n=269)**
Nausea	6%	5%	19%	6%
Diarrhea	5%	8%	15%	9%
Insomnia	6%	6%	14%	6%
Fatigue	3%	4%	8%	3%
Vomiting	3%	3%	8%	5%
Muscle cramps	2%	6%	8%	3%
Anorexia	2%	3%	7%	3%

Adverse Events Reported in Controlled Trials The events cited reflect experience gained under closely monitored conditions of clinical trials in a highly selected patient population. In actual clinical practice or in other clinical trials, these frequency estimates may not apply, as the conditions of use, reporting behavior, and the kinds of patients treated may differ. Table 3 lists treatment emergent signs and symptoms that were reported in at least 2% of patients in placebo-controlled trials who received ARICEPT® and for which the rate of occurrence was greater for ARICEPT® assigned than placebo assigned patients. In general, adverse events occurred more frequently in female patients and with advancing age.

Table 3. Adverse Events Reported in Controlled Clinical Trials in at Least 2% of Patients Receiving ARICEPT® (donepezil HCl) and at a Higher Frequency than Placebo-treated Patients

Body System/Adverse Event	Placebo (n=355)	ARICEPT® (n=747)
Percent of Patients with any Adverse Event	**72**	**74**
Body as a Whole		
Headache	9	10
Pain, various locations	8	9
Accident	6	7
Fatigue	3	5
Cardiovascular System		
Syncope	1	2
Digestive System		
Nausea	6	11
Diarrhea	5	10
Vomiting	3	5
Anorexia	2	4
Hemic and Lymphatic System		
Ecchymosis	3	4
Metabolic and Nutritional Systems		
Weight Decrease	1	3
Musculoskeletal System		
Muscle Cramps	2	6
Arthritis	1	2
Nervous System		
Insomnia	6	9
Dizziness	6	8
Depression	<1	3
Abnormal Dreams	0	3
Somnolence	<1	2
Urogenital System		
Frequent Urination	1	2

Other Adverse Events Observed During Clinical Trials ARICEPT® has been administered to over 1700 individuals during clinical trials worldwide. Approximately 1200 of these patients have been treated for at least 3 months and more than 1000 patients have been treated for at least 6 months. Controlled and uncontrolled trials in the United States included approximately 900 patients. In regards to the highest dose of 10 mg/day, this population includes 650 patients treated for 3 months, 475 patients treated for 6 months and 116 patients treated for over 1 year. The range of patient exposure is from 1 to 1214 days. Treatment emergent signs and symptoms that occurred during 3 controlled clinical trials and two open-label trials in the United States were recorded as adverse events by the clinical investigators using terminology of their own choosing. To provide an overall estimate of the proportion of individuals having similar types of events, the events were grouped into a smaller number of standardized categories using a modified COSTART dictionary and event frequencies were calculated across all studies. These categories are used in the listing below. The frequencies represent the proportion of 900 patients from these trials who experienced that event while receiving ARICEPT®. All adverse events occurring at least twice are included, except for those already listed in Tables 2 or 3, COSTART terms too general to be informative, or events less likely to be drug caused. Events are classified by body system and listed using the following definitions: *frequent adverse events*—those occurring in at least 1/100 patients; *infrequent adverse events*—those occurring in 1/100 to 1/1000 patients. These adverse events are not necessarily related to ARICEPT® treatment and in most cases were observed at a similar frequency in placebo-treated patients in the controlled studies. No important additional adverse events were seen in studies conducted outside the United States. **Body as a Whole:** *Frequent:* influenza, chest pain, toothache; *Infrequent:* fever, edema face, periorbital edema, hemiatal, abscess, cellulitis, chills, generalized coldness, head fullness, listlessness. **Cardiovascular System:** *Frequent:* hypertension, vasodilation, atrial fibrillation, hot flashes, hypotension; *Infrequent:* angina pectoris, postural hypotension, myocardial infarction, AV block (first degree), congestive heart failure, arteritis, bradycardia, peripheral vascular disease, supraventricular tachycardia, deep vein thrombosis. **Digestive System:** *Frequent:* fecal incontinence, gastrointestinal bleeding, bloating, epigastric pain; *Infrequent:* eructation, gingivitis, increased appetite, flatulence, periodontal abscess, cholelithiasis, diverticulitis, drooling, dry mouth, fever sore, gastritis, irritable colon, tongue edema, epigastric distress, gastroenteritis, increased transaminases, hemorrhoids, ileus, increased thirst, jaundice, melena, polydipsia, duodenal ulcer, stomach ulcer. **Endocrine System:** *Infrequent:* diabetes mellitus, goiter. **Hemic and Lymphatic System:** *Infrequent:* anemia, thrombocythemia, thrombocytopenia, eosinophilia, erythrocytopenia. **Metabolic and Nutritional Disorders:** *Frequent:* dehydration; *Infrequent:* gout, hypokalemia, increased creatine kinase, hyperglycemia, weight increase, increased lactate dehydrogenase. **Musculoskeletal System:** *Frequent:* bone fracture; *Infrequent:* muscle weakness, muscle fasciculation. **Nervous System:** *Frequent:* delusions, tremor, irritability, paresthesia, aggression, vertigo, ataxia, increased libido, restlessness, abnormal crying, nervousness, aphasia; *Infrequent:* cerebrovascular accident, intracranial hemorrhage, transient ischemic attack, emotional lability, neuralgia, coldness (localized), muscle spasm, dysphoria, gait abnormality, hypertonia, hypokinesia, neurodermatitis, numbness (localized), paranoia, dysarthria, dysphasia, hostility, decreased libido, melancholia, emotional withdrawal, nystagmus, pacing. **Respiratory System:** *Frequent:* dyspnea, sore throat, bronchitis; *Infrequent:* epistaxis, post nasal drip, pneumonia, hyperventilation, pulmonary congestion, wheezing, hypoxia, pharyngitis, pleurisy, pulmonary collapse, sleep apnea, snoring. **Skin and Appendages:** *Frequent:* pruritus, diaphoresis, urticaria; *Infrequent:* dermatitis, erythema, skin discoloration, hyperkeratosis, alopecia, fungal dermatitis, herpes zoster, hirsutism, skin striae, night sweats, skin ulcer. **Special Senses:** *Frequent:* cataract, eye irritation, vision blurred; *Infrequent:* dry eyes, glaucoma, earache, tinnitus, blepharitis, decreased hearing, retinal hemorrhage, otitis externa, otitis media, bad taste, conjunctival hemorrhage, ear buzzing, motion sickness, spots before eyes. **Urogenital System:** *Frequent:* urinary incontinence, nocturia; *Infrequent:* dysuria, hematuria, urinary urgency, metrorrhagia, cystitis, enuresis, prostate hypertrophy, pyelonephritis, inability to empty bladder, breast fibroadenosis, fibrocystic breast, mastitis, pyuria, renal failure, vaginitis. **Postintroduction Reports** Voluntary reports of adverse events temporally associated with ARICEPT® that have been received since market introduction that are not listed above, and that there is inadequate data to determine the causal relationship with the drug include the following: abdominal pain, agitation, cholecystitis, confusion, convulsions, hallucinations, heart block (all types), hemolytic anemia, hepatitis, hyponatremia, neuroleptic malignant syndrome, pancreatitis, and rash. **OVERDOSAGE Because strategies for the management of overdose are continually evolving, it is advisable to contact a Poison Control Center to determine the latest recommendations for the management of an overdose of any drug.** As in any case of overdose, general supportive measures should be utilized. Overdosage with cholinesterase inhibitors can result in cholinergic crisis characterized by severe nausea, vomiting, salivation, sweating, bradycardia, hypotension, respiratory depression, collapse and convulsions. Increasing muscle weakness is a possibility and may result in death if respiratory muscles are involved. Tertiary anticholinergics such as atropine may be used as an antidote for ARICEPT® overdosage. Intravenous atropine sulfate titrated to effect is recommended, an initial dose of 1.0 to 2.0 mg IV with subsequent doses based upon clinical response. Atypical responses in blood pressure and heart rate have been reported with other cholinomimetics when co-administered with quaternary anticholinergics such as glycopyrrolate. It is not known whether ARICEPT® and/or its metabolites can be removed by dialysis (hemodialysis, peritoneal dialysis, or hemofiltration). Dose-related signs of toxicity in animals included reduced spontaneous movement, prone position, staggering gait, lacrimation, clonic convulsions, depressed respiration, salivation, miosis, tremors, fasciculation and lower body surface temperature. **DOSAGE AND ADMINISTRATION** The dosages of ARICEPT® shown to be effective in controlled clinical trials are 5 mg and 10 mg administered once per day. The higher dose of 10 mg did not provide a statistically significantly greater clinical benefit than 5 mg. There is a suggestion, however, based upon order of group mean scores and dose trends in analyses of data from these clinical trials, that a daily dose of 10 mg of ARICEPT® might provide additional benefit for some patients. Accordingly, whether or not to employ a dose of 10 mg is a matter of prescriber and patient preference. Evidence from the controlled trials indicates that the 10 mg dose, with a one week titration, is likely to be associated with a higher incidence of cholinergic adverse events than the 5 mg dose. In open label trials using a 6 week titration, the frequency of these same adverse events was similar between the 5 mg and 10 mg dose groups. Therefore, because steady state is not achieved for 1 days and because the incidence of untoward effects may be influenced by the rate of dose escalation, treatment with a dose of 10 mg should not be contemplated until patients have been on a daily dose of 5 mg for 4 to 6 weeks. ARICEPT® should be taken in the evening, just prior to retiring, and may be taken with or without food.

Eisai Inc. Teaneck, NJ 07666 · Pfizer U.S. Pharmaceuticals New York, NY 10017

200177 Revised December 200

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AMERICA. CHAPTER I.

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CULTURAL PRESERVATION

An Archaeologist's Lament

Mourning the sack of the Iraq Museum, an expert assesses the toll

MUSHIN HASAN, DEPUTY DIRECTOR OF THE IRAQ MUSEUM, THE DAY AFTER LOOTING SUBSIDED. MARIO TAMA, GETTY IMAGES

When bombs started falling on Iraq in March, I had the same first thought that every archaeologist who's ever done fieldwork there must have had: What will happen to the Iraqis who worked with us—people who welcomed us into their homes? Fortunately that question has been answered: My friends and colleagues survived the war.

But I soon saw my second greatest fear become reality: Much of the unique record of the Mesopotamian civilization that blossomed between the Tigris and Euphrates Rivers 6,000 years ago was stolen or irreparably damaged. Tens of thousands of artifacts at the Iraq Museum in Baghdad were lost over the course of three chaotic days in early April. Not all of these treasures were claimed by frenzied mobs of looters. Some were probably stolen in an organized plot by art thieves, a scheme that might have been thwarted had coalition forces heeded pleas from the world's archaeologists to protect the museum.

Among the museum's collections were not only the statues of gods and goddesses, the possessions of kings and queens, law codes and religious texts, but also the mundane items of daily life. There were the 60,000-year-old flint tools and fragmentary skeletons of early humans from Shanidar Cave in the mountains of northern Iraq. There were sickle blades left by some of the world's first farmers 10,000 years ago. And there were tens of thousands of pottery fragments, which not only tell us about everyday activities in the past eight millennia, but also (because their styles change rapidly and these changes have been carefully studied) enable archaeologists to know the age of layers in which they're found.

Perhaps the most valuable artifacts were thousands of clay tablets covered with cuneiform signs, written between 3200 B.C. and A.D. 75. It's unclear how many of these tablets were lost, but each one is a treasure for scholars. All early civilizations kept

LOST WORLD? A gallery of priceless artifacts from the Iraq Museum in Baghdad

LYNN ABERCROMBIE

Statue of Sumerian worshiper

DATE: circa 2600 B.C.
This stone statue was placed in a temple to pray perpetually for the life of the donor. Religion and ritual performed a fundamental role in the lives of early Mesopotamians.
STATUS: Unknown

LYNN ABERCROMBIE

Cuneiform calendar from Nimrud

DATE: circa 850 B.C.
Written almost 2,500 years after Sumerians created cuneiform—the world's first writing—this small tablet listed daily instructions for the seventh month of the year. Example: Avoid eating garlic on the second day or risk a death in the family.
STATUS: Unknown

Mosque door

DATE: 12th century A.D.
Adorned with floral and geometric designs, a rare two-panel door from a mosque in the city of Mosul was crafted 500 years after Islam took root in Iraq.
STATUS: Stolen

LYNN ABERCROMBIE

Warka head

DATE: circa 3000 B.C.
One of the most refined pieces of early sculpture, this life-size marble head of a woman originally had a headdress and eyes and eyebrows of inlaid stone. It was possibly part of a statue of Inana, Sumerian goddess of love and war.
STATUS: Stolen

Bassetki statue

DATE: circa 2250 B.C.
An inscription on the base of the 350-pound cast-copper monument proclaims the military victories of an Akkadian king. Though only the bottom half of the male figure was intact when discovered, it was prized for its realism. Such statues were commonly depicted in artwork from the time, but this was the only example discovered so far.
STATUS: Stolen

LYNN ABERCROMBIE

Gold bull-headed lyre

DATE: circa 2500 B.C.
An exquisite example of the lyre—an instrument invented by the Sumerians around 3200 B.C.—from the royal cemetery of Ur. The gold-covered bull's head was attached to a sound box decorated with colored stones and bits of shell.
STATUS: Gold torn off

ERIK TRINKAUS

Shanidar skull

DATE: circa 50,000 years old
Skeletons from Shanidar Cave are the only Neandertal fossils found to date in southwest Asia east of the Jordan River. This skull belonged to a male who suffered severe injuries yet lived to the relatively old age of 45—evidence of social behavior: To survive he must have been cared for by members of his group.
STATUS: Unknown

Boat model

DATE: circa 4500 B.C.
Found in an Ubaid grave at a site called Eridu, a baked clay model of a boat (its wood mast is restored) is the best preserved example of early water transport in Mesopotamia.
STATUS: Unknown

GIANNI DAGLI ORTI, CORBIS

Warka vase

DATE: circa 3000 B.C.
One of the earliest depictions of the hierarchy of the world as understood by the Mesopotamians: plants, animals, humans, and gods. The alabaster vase was a valuable commodity in its time.
STATUS: Stolen

SCALA/ART RESOURCE, NY

Lions of Tell Harmal

DATE: circa 1800 B.C.
Two large, snarling lions in terra-cotta guarded the entrance to a temple. To Mesopotamians they were fearful symbols of gods and kings.
STATUS: Heads smashed

LYNN ABERCROMBIE

Little king

DATE: circa 3000 B.C.
With inlaid eyes of shell and lapis lazuli, this finely carved alabaster figure stands just seven inches tall. Found beneath a temple in the ancient city of Uruk (today's Warka), it was likely a portrait of En, the city's ruler.
STATUS: Unknown

LYNN ABERCROMBIE

Stone statue of a Sumerian scribe

DATE: circa 2400 B.C.
This high official of the city of Girsu may have established a system of weights and measures. Stone blocks roughly equivalent to 24 ounces have been found inscribed with his name.
STATUS: Unknown

STEVE MCCURRY

Lioness killing a Nubian shepherd

DATE: late eighth century B.C.
Made of ivory; color was added with inlays of gold, carnelian, and lapis lazuli.
STATUS: Unknown

LYNN ABERCROMBIE

Lizard-faced terra-cotta figurine

DATE: circa 4000 B.C.
This curious effigy of a human male is characteristic of the Ubaid culture. Male and female figurines with lizard-like faces have been found in graves and temples at Ur and Eridu.
STATUS: Unknown

—Clemens Reichel, Marisa J. Larson, and Jeanne E. Peters
Artifact status accurate at press time.

WEBSITE EXCLUSIVE

For updates on the status of artifacts—and links to other sites and resources about Iraq's heritage—go to **nationalgeographic.com/ngm/0307.**

AFTERMATH OF MAYHEM. PATRICK BAZ, AFP

daily records, but most were on perishable materials that vanished long ago (papyrus in Egypt, palm leaves in India, wood and bamboo in China, cotton and wool twine in Peru). But these clay tablets were different. With careful excavation, cleaning, and baking for preservation, the tablets revealed everything from business accounts to intimate letters between friends. Because lab work is expensive and few specialists can read the long-dead Sumerian and Akkadian languages, the work is slow, and many of the tablets were as yet unbaked and unread.

The looting and damage of the museum may not be the only archaeological tragedy. Innumerable artifacts remain unexcavated across the country. Some 160 years of excavation have taught us much about Iraq's ancient cities, but our understanding of thousands of smaller rural sites is based largely on hasty preliminary surveys. In these surveys we've learned that ancient landscapes are often surprisingly well preserved but fragile, unlikely to survive the passage of heavy armored vehicles. I well remember finding 3,300-year-old plow furrows, with water jars still lying by small feeder canals, near Ur in southern Iraq, an area that this spring saw much conflict—and plenty of tank traffic.

We may never know how many unexcavated finds were crushed by tanks, how many fragile objects were shattered by looters, or how many of the museum's artifacts were sold to private collectors or melted down for their gold. As soon as reports of the looting reached us, we begged authorities to inspect vehicles leaving Iraq and to urge citizens to return objects to the museum voluntarily—which some began doing within days. (Apparently some artifacts had been stashed for safekeeping by well-meaning individuals.) Officials and scholars rushed to reconstruct collection records, many of which are duplicated in the records of institutions around the world that sponsor scientific excavation. And teams of museum professionals from several countries have joined Iraqi curators to compile a definitive, illustrated inventory of what's been taken—a list that's being circulated to Interpol, national police forces, museums, and responsible galleries.

Thanks to these efforts, by the time you read this some of the items pictured on the previous page may have been found. But I'm not naive: No matter what we do to get these pieces back, we'll never find them all. In my 48 years as an archaeologist I've never felt so angry about the abuse of the past. What has been lost is not only the heritage of a nation; it is the heritage of the world.

—Henry Wright
NGS COMMITTEE FOR RESEARCH AND EXPLORATION

HELP MAINTAIN CONNECTIONS TO THE PAST

The devastating loss of Iraq's historic treasures isn't an isolated event. Around the world artifacts and monuments are threatened by war, the elements, and a lack of resources to preserve them. In response, the Society has created the **World Cultures Fund** to support the work of archaeologists, curators, and artists wherever the history of civilizations is at risk. One of the fund's flagship projects is an expedition led by Henry Wright to assess the status of Iraq's cultural resources.

You can support this expedition and preserve cultural treasures worldwide by going to **nationalgeographic.com/help**, clicking on "Urgent Funding Need," and donating online. Gifts may also be mailed to **World Cultures Fund, National Geographic Society Development Office, 1145 17th Street NW, Washington, DC 20036**.

—John M. Fahey, Jr.
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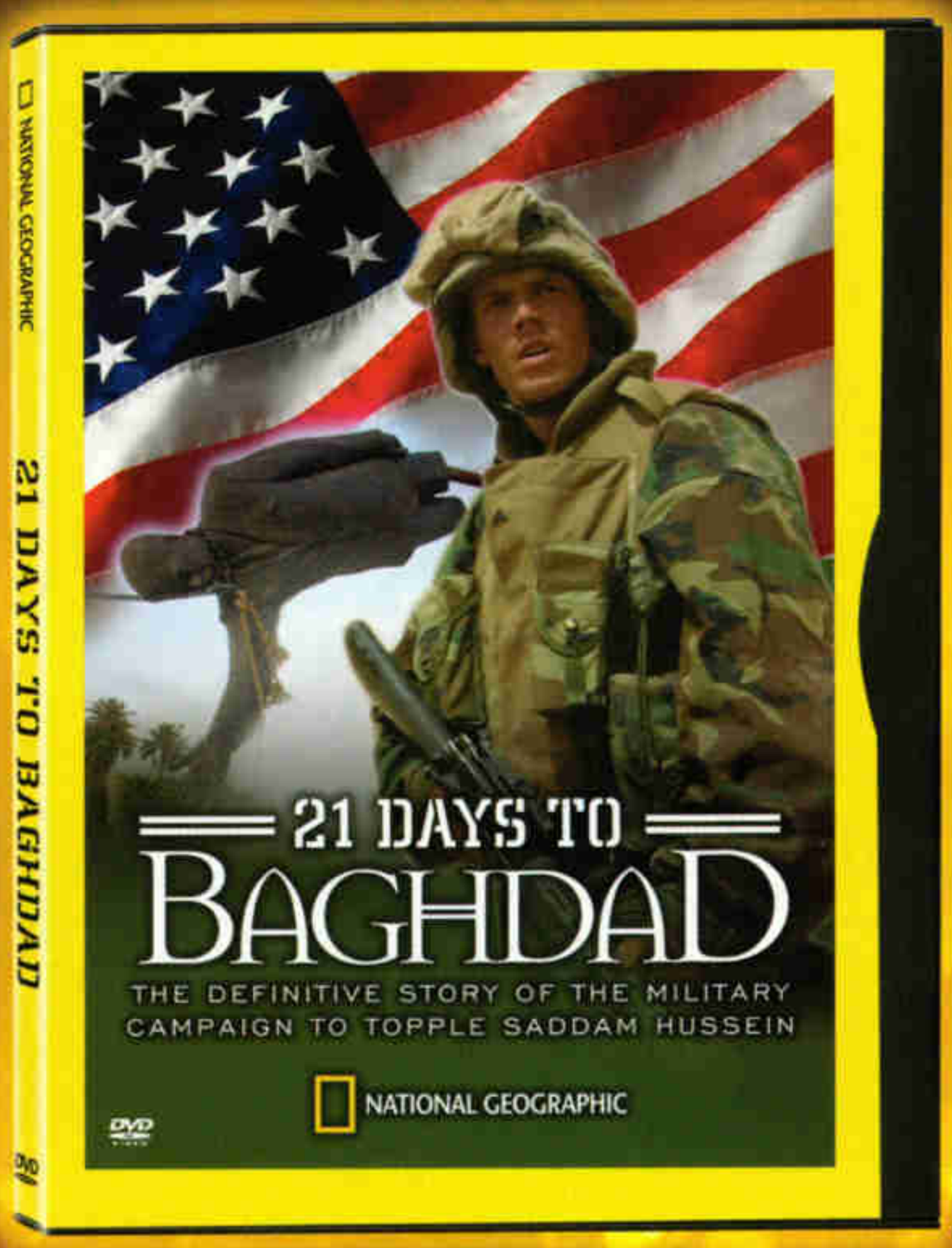

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Legal Notice

If You Purchased the Drug BuSpar® or buspirone HCl from February 5, 1995, through January 31, 2003

Your Rights May Be Affected by a Class Action Settlement.

There is a proposed settlement of the class action lawsuit, *In re Buspirone Antitrust Litigation, MDL-1413* (S.D.N.Y.), brought by the Attorneys General of 50 states, Puerto Rico and the District of Columbia. Under the terms of the Settlement, you may be able to make a claim for a recovery for your purchase of BuSpar® or buspirone HCl.

What is the Lawsuit About?

Plaintiffs allege that Bristol-Myers Squibb ("BMS") engaged in fraudulent conduct and conspired with a potential competitor to prevent the entry of generic competitors and illegally maintain its monopoly in the United States over the sale of buspirone hydrochloride-based prescription drugs. Through its unlawful actions, generic competition in the sale of buspirone HCl was prevented, causing consumers and government entities to pay higher prices for BuSpar® and buspirone HCl and lose the substantial cost savings that generic versions of the same drugs would have produced. Defendants have denied any wrongdoing or liability.

Can I Benefit From the Settlement?

If you are a consumer within the United States, including Puerto Rico, who purchased BuSpar® or generic buspirone HCl in the United States or Puerto Rico from February 5, 1995, through January 31, 2003, you are a member of the Settlement Class. However, only if you made purchases from January 1, 1998, through January 31, 2003, will you be able to file a claim for a cash recovery.

What are the Terms of the Settlement?

Approximately $41.7 million has been set aside to reimburse consumers some portion of any alleged overcharges that they may have incurred from purchasing BuSpar® or buspirone HCl during the claims period.

What Are My Legal Rights?

- If you wish to remain a member of the Settlement Group, you do not need to take any action to remain a member. However, to share in the settlement fund you must file a claim as discussed below. If the Court approves the proposed Settlement, you will be bound by all orders of the Court and any legal claims you may have against the Defendants relating to the conduct alleged in the lawsuit will be released.
- If you do not wish to remain a member of the Settlement Group, you must mail a written request for exclusion, postmarked on or before October 10, 2003, to the BuSpar® Antitrust Litigation Administrator at PO Box 1682, Faribault, MN 55021-1682. If you do not mail a written request for exclusion, you will remain a member of the Settlement Group.
- As a member of the Settlement Group, you may object to the Proposed Settlement, enter an appearance in this matter through counsel, or appear at the final approval hearing.

What is BuSpar®?

BuSpar® is a brand-name prescription drug containing buspirone hydrochloride as its active pharmaceutical ingredient. BuSpar® is a medication for treating patients suffering from generalized anxiety disorder.

How Can I File a Claim?

If you remain a member of the Settlement Group and you wish to be reimbursed for some portion of the alleged overcharge you incurred, you must file a claim by October 10, 2003, with the BuSpar® Antitrust Litigation Administrator. Claim forms and additional information can be requested by visiting www.busparsettlement.com, calling the toll-free number below, or writing the BuSpar® Antitrust Litigation Administrator at the address listed below.

When Will the Settlement Be Approved?

The Court will hold a final approval hearing on the proposed Settlement on November 6, 2003, at 4:30 pm in the Courtroom of the Honorable John G. Koeltl, at the Daniel Patrick Moynihan United States Courthouse, 500 Pearl St., New York, New York 10007-1312.

For Information on Your Legal Rights, the Notice of Proposed Settlement, and to Request a Claim Form:

Visit: www.busparsettlement.com or Call: 1-800-678-9587

Or write: BuSpar® Antitrust Litigation Administrator, PO Box 1682, Faribault, MN 55021-1682

Behind the SCENES

AT THE NATIONAL GEOGRAPHIC SOCIETY

NGS PHOTOGRAPHER MARK THIESSEN

Big Is Beautiful

Paintings of China fill a broad canvas

Almost all the artists who paint for NATIONAL GEOGRAPHIC work on canvases larger than these pages, but they've seldom created paintings as large as Chinese-born artist Hongnian Zhang's extraordinary work for the story on the Shang and other Bronze Age cultures. Each of his three paintings measures eight feet wide and four feet high, making them perhaps the biggest created for the magazine since the 1920s. Each took a month to paint; Hongnian was still putting the finishing touches on them in the Society's photographic studio (above), just before transparencies were shot for reproduction in the magazine.

Why work big? Hongnian says it gives his work more power. Chris Sloan, the magazine's art director, says it's difficult for artists to capture detail on a small canvas, and that reducing a large painting for publication eliminates brushstrokes and can make scenes look more realistic. Chris liked the big versions too: He bought the canvases to add to the Society's permanent collection.

NO SEX, PLEASE

When illustrations editor Kathy Moran began to assemble photos for this month's article on sexual selection, she e-mailed some 250 photographers and photographic agencies around the world, asking for their help. But a quarter of the e-mails bounced back unread to Kathy and her assistant, Leah Boonthanom. Eventually they learned why: Many automatic e-mail filtering systems read the subject line, "Sexual Selection Article," to mean that NATIONAL GEOGRAPHIC was sending them pornography. "We'd probably have been better off calling it 'The Birds and the Bees,'" Kathy says.

Yellow-faced Amazon *(Amazona xanthops)*
Size: Length, 26-27 cm **Weight:** Less than 200 g
Habitat: Semi-arid scrubland with low cerrado trees throughout eastern and central Brazil
Surviving number: Unknown; populations declining

Photographed by Frans Lanting

WILDLIFE AS CANON SEES IT

Looks *can* kill. Witness the yellow-faced amazon, whose gorgeous plumage makes it a tempting target for the worldwide wild animal trade. Noisy and eye-catching, the charismatic parrot is not the hardest bird to spot. It travels in pairs or flocks numbering as high as the thirties, ranging widely in search of its favorite foods: seeds and fruit, particularly mangoes. Its liking for mangoes is so strong, in fact, that it brings the bold bird perilously near human plantations and habitations. While the yellow-faced amazon's beauty makes it an object of desire around the world, its home range is suffering rapid, ongoing destruction.

As an active, committed global corporation, we join worldwide efforts to promote awareness of endangered species. Just one way we are working to make the world a better place—today and tomorrow.

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NATURE
Watch NATURE on PBS. This program is funded, in part, by Canon.

Canon

A Scientist's Tiny Discovery

Ultimate Explorer's Mayor finds new primate

Mireya Mayor leads a double life. On Sunday nights she's on the air as a correspondent for National Geographic *Ultimate Explorer.* Otherwise she's a Fulbright scholar and primatologist about to earn her doctorate in anthropology from Stony Brook University. Now she has yet another distinction: She's part of a team that discovered a new species of mouse lemur—the smallest primates known to science—in Madagascar.

Mireya and colleagues from Omaha's Henry Doorly Zoo were doing fieldwork on the island nation's northeast coast on endangered primates, studying their behavior, diet, and genetic makeup. One rainy night she and project leader Edward Louis set out half a dozen traps

NGS PHOTOGRAPHER MARK THIESSEN

in the mountainous rain forest. When they checked them the next day, they found a "semi-frozen" mouse lemur—a nocturnal species that builds nests in trees—huddled inside one trap.

"We filled a plastic bag to create a makeshift hot-water bottle, and I held the animal against me to let it get some of my body heat," she says. "Eventually it came around."

The specimen, an easy handful for Mireya (left), looked different from other mouse lemurs, and genetic tests confirmed that it was a species never before reported.

Mireya returned to the area with an *Ultimate Explorer* camera crew and observed half a dozen of the creatures. The resulting show, *King Kong in My Pocket,* will be broadcast on Sunday, June 29, at 8 p.m. ET/PT on MSNBC.

TOOL BOX

Mission Getting close enough to photograph Atlantic salmon (see page 100) without scaring them away.
Tool Closed-circuit rebreather.
How it works Rebreathers recycle air, removing carbon dioxide with chemical scrubbers and adding oxygen as needed. "You can stay down up to two hours," says photographer Paul Nicklen (right), "and you don't put bubbles in the water. Salmon hate bubbles."

PAUL NICKLEN

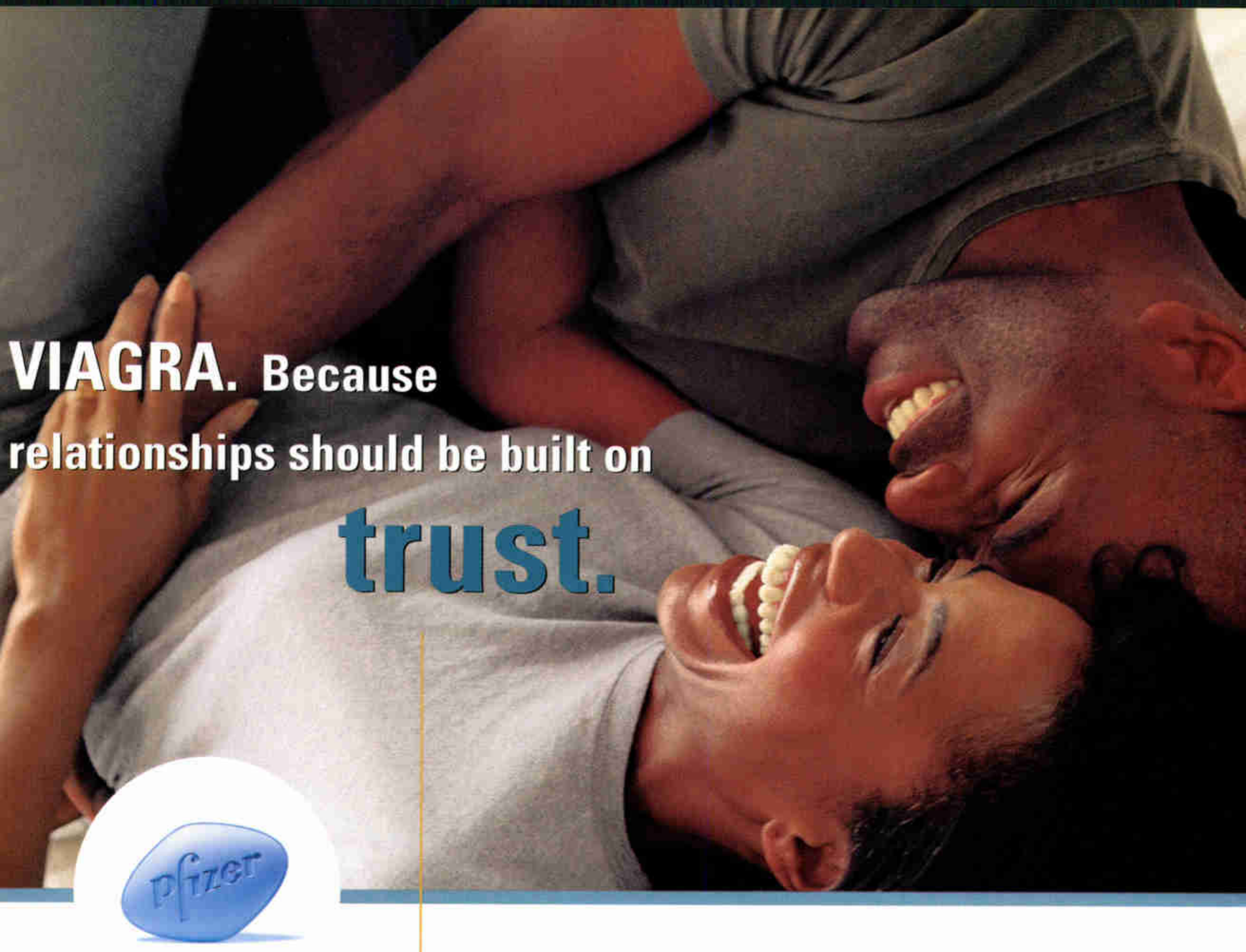
GET MORE

To learn more about a subject covered in this issue, try these National Geographic Society products and services. Call 1-888-225-5647 or log on to *nationalgeographic.com* for more information.

NATIONAL GEOGRAPHIC

NEW STORY OF CHINA'S PAST (PAGE 56)

- **China Expedition.** Explore Bronze Age China and cruise the Yangtze River with National Geographic Expeditions in October 2003. For information visit *nationalgeographic.com/ngexpeditions* or call 1-888-966-8687.
- **China Political Map** created by National Geographic Maps ($10.99).
- **China's Ancient Past Online.** View a portfolio of more photos by O. Louis Mazzatenta on the Shang dynasty and recent Bronze Age discoveries, click on Web links, and get a bibliography of the magazine story at *nationalgeographic.com/ngm/0307.* Exclusive photos, links, and a bibliography appear online for all feature magazine articles.



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And why not? VIAGRA is the only ED treatment that has improved the sex lives of more than 19 million men worldwide. What's more:

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THE ONE THAT WORKS FOR MILLIONS.™

VIAGRA is indicated for the treatment of erectile dysfunction.

Remember that no medicine is for everyone. If you use nitrate drugs, often used to control chest pain (also known as angina), don't take VIAGRA. This combination could cause your blood pressure to drop to an unsafe or life-threatening level.

Discuss your general health status with your doctor to ensure that you are healthy enough to engage in sexual activity. If you experience chest pain, nausea, or any other discomforts during sex or an erection that lasts longer than 4 hours, seek immediate medical help. The most common side effects of VIAGRA are headache, facial flushing, and upset stomach. Less commonly, bluish vision, blurred vision, or sensitivity to light may briefly occur.

Please see patient summary of information for VIAGRA (25-*mg*, 50-*mg*, 100-*mg*) *tablets on the following page.*

The one that works for millions.™

PATIENT SUMMARY OF INFORMATION ABOUT

VIAGRA®
(sildenafil citrate) tablets

This summary contains important information about VIAGRA®. It is not meant to take the place of your doctor's instructions. Read this information carefully before you start taking VIAGRA. Ask your doctor or pharmacist if you do not understand any of this information or if you want to know more about VIAGRA.

This medicine can help many men when it is used as prescribed by their doctors. However, VIAGRA is not for everyone. It is intended for use only by men who have a condition called erectile dysfunction. **VIAGRA must never be used by men who are taking medicines that contain nitrates of any kind, at any time. This includes nitroglycerin. If you take VIAGRA with any nitrate medicine your blood pressure could suddenly drop to an unsafe or life threatening level.**

What Is VIAGRA?

VIAGRA is a pill used to treat erectile dysfunction (impotence) in men. It can help many men who have erectile dysfunction get and keep an erection when they become sexually excited (stimulated).

You will not get an erection just by taking this medicine. VIAGRA helps a man with erectile dysfunction get an erection only when he is sexually excited.

How Sex Affects the Body

When a man is sexually excited, the penis rapidly fills with more blood than usual. The penis then expands and hardens. This is called an erection. After the man is done having sex, this extra blood flows out of the penis back into the body. The erection goes away. If an erection lasts for a long time (more than 6 hours), it can permanently damage your penis. You should call a doctor immediately if you ever have a prolonged erection that lasts more than 4 hours.

Some conditions and medicines interfere with this natural erection process. The penis cannot fill with enough blood. The man cannot have an erection. This is called erectile dysfunction if it becomes a frequent problem.

During sex, your heart works harder. Therefore sexual activity may not be advisable for people who have heart problems. Before you start any treatment for erectile dysfunction, ask your doctor if your heart is healthy enough to handle the extra strain of having sex. If you have chest pains, dizziness or nausea during sex, stop having sex and immediately tell your doctor you have had this problem.

How VIAGRA Works

VIAGRA enables many men with erectile dysfunction to respond to sexual stimulation. When a man is sexually excited, VIAGRA helps the penis fill with enough blood to cause an erection. After sex is over, the erection goes away.

VIAGRA Is Not for Everyone

As noted above (*How Sex Affects the Body*), ask your doctor if your heart is healthy enough for sexual activity.

If you take any medicines that contain nitrates–either regularly or as needed–you should never take VIAGRA. If you take VIAGRA with any nitrate medicine or recreational drug containing nitrates, your blood pressure could suddenly drop to an unsafe level. You could get dizzy, faint, or even have a heart attack or stroke. Nitrates are found in many prescription medicines that are used to treat angina (chest pain due to heart disease) such as:

- nitroglycerin (sprays, ointments, skin patches or pastes, and tablets that are swallowed or dissolved in the mouth)
- isosorbide mononitrate and isosorbide dinitrate (tablets that are swallowed, chewed, or dissolved in the mouth)

Nitrates are also found in recreational drugs such as amyl nitrate or nitrite ("poppers"). If you are not sure if any of your medicines contain nitrates, or if you do not understand what nitrates are, ask your doctor or pharmacist.

VIAGRA is only for patients with erectile dysfunction. VIAGRA is not for newborns, children, or women. Do not let anyone else take your VIAGRA. VIAGRA must be used only under a doctor's supervision.

What VIAGRA Does Not Do

- VIAGRA does not cure erectile dysfunction. It is a treatment for erectile dysfunction.
- VIAGRA does not protect you or your partner from getting sexually transmitted diseases, including HIV–the virus that causes AIDS.
- VIAGRA is not a hormone or an aphrodisiac.

What To Tell Your Doctor Before You Begin VIAGRA

Only your doctor can decide if VIAGRA is right for you. VIAGRA can cause mild, temporary lowering of your blood pressure. You will need to have a thorough medical exam to diagnose your erectile dysfunction and to find out if you can safely take VIAGRA alone or with your other medicines. Your doctor should determine if your heart is healthy enough to handle the extra strain of having sex.

Be sure to tell your doctor if you:

- have ever had any heart problems (e.g., angina, chest pain, heart failure, irregular heart beats, heart attack or narrowing of the aortic valve)
- have ever had a stroke
- have low or high blood pressure
- have a rare inherited eye disease called retinitis pigmentosa
- have ever had any kidney problems
- have ever had any liver problems
- have ever had any blood problems, including sickle cell anemia or leukemia
- are allergic to sildenafil or any of the other ingredients of VIAGRA tablets
- have a deformed penis, Peyronie's disease, or ever had an erection that lasted more than 4 hours
- have stomach ulcers or any types of bleeding problems
- are taking any other medicines

VIAGRA and Other Medicines

Some medicines can change the way VIAGRA works. Tell your doctor about **any medicines** are taking. Do not start or stop taking any medicines before checking with your doctor or pharmacist. This includes prescription and nonprescription medicines or remedies.

- Remember, VIAGRA should never be used with medicines that contain nitrates (see *VIAGRA Is Not for Everyone*).
- If you are taking alpha-blocker therapy for the treatment of high blood pressure or prostate problems, you should not take a dose of greater than 25 mg of VIAGRA at the same time (within 4 hours) as you take your dose of alpha-blocker.
- If you are taking a protease inhibitor, your dose may be adjusted (please see *Finding the Right Dose for You.*)
- VIAGRA should not be used with any other medical treatments that cause erections. T treatments include pills, medicines that are injected or inserted into the penis, implant vacuum pumps.

Finding the Right Dose for You

VIAGRA comes in different doses (25 mg, 50 mg and 100 mg). If you do not get the results y expect, talk with your doctor. You and your doctor can determine the dose that works best for y

- Do not take more VIAGRA than your doctor prescribes.
- If you think you need a larger dose of VIAGRA, check with your doctor.
- VIAGRA should not be taken more than once a day.

If you are older than age 65, or have serious liver or kidney problems, your doctor may start y at the lowest dose (25 mg) of VIAGRA. If you are taking protease inhibitors, such as for the treatment of HIV, your doctor may recommend a 25 mg dose and may limit you to a maximun single dose of 25 mg of VIAGRA in a 48 hour period. If you are taking alpha-blocker therapy, should not take a dose of greater than 25 mg of VIAGRA at the same time (within 4 hours) as your dose of alpha-blocker.

How To Take VIAGRA

Take VIAGRA about one hour before you plan to have sex. Beginning in about 30 minutes and up to 4 hours, VIAGRA can help you get an erection if you are sexually excited. If you take VIAGRA after a high-fat meal (such as a cheeseburger and french fries), the medicine may tak a little longer to start working. VIAGRA can help you get an erection when you are sexually excited. You will not get an erection just by taking the pill.

Possible Side Effects

Like all medicines, VIAGRA can cause some side effects. These effects are usually mild to moderate and usually don't last longer than a few hours. Some of these side effects are more likely to occur with higher doses. The most common side effects of VIAGRA are headache, flushing of the face, and upset stomach. Less common side effects that may occur are tempo changes in color vision (such as trouble telling the difference between blue and green objects having a blue color tinge to them), eyes being more sensitive to light, or blurred vision.

In rare instances, men have reported an erection that lasts many hours. You should call a doc immediately if you ever have an erection that lasts more than 4 hours. If not treated right awa permanent damage to your penis could occur (see *How Sex Affects the Body*).

Heart attack, stroke, irregular heart beats, and death have been reported rarely in men taking VIAGRA. Most, but not all, of these men had heart problems before taking this medicine. It is not possible to determine whether these events were directly related to VIAGRA.

VIAGRA may cause other side effects besides those listed on this sheet. If you want more information or develop any side effects or symptoms you are concerned about, call your doct

Accidental Overdose

In case of accidental overdose, call your doctor right away.

Storing VIAGRA

Keep VIAGRA out of the reach of children. Keep VIAGRA in its original container. Store at 25° (77°F); excursions permitted to 15-30°C (59-86°F) [see USP Controlled Room Temperature]

For More Information on VIAGRA

VIAGRA is a prescription medicine used to treat erectile dysfunction. Only your doctor can de if it is right for you. This sheet is only a summary. If you have any questions or want more information about VIAGRA, talk with your doctor or pharmacist, visit www.viagra.com, or call 1-888-4VIAGRA.

23-5515-00-6 Rev. 6 Sept. 2

VIAGRA®
(sildenafil citrate) tablets

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Who Knew?

INNOVATION

Technophobia?

How tools grow up to be toys

New technologies are always a little scary. In Michael Crichton's recent novel, *Prey,* microscopic cameras designed to diagnose disease in humans somehow turn into a crafty, carnivorous robotic swarm that eats people alive. (Monsters are more complicated than they used to be.)

Bill Joy, co-founder of Sun Microsystems, has warned that the merger of biotechnology and nanotechnology could endanger the human species. Fiendish scientists might, in theory, engineer lethal, molecule-size, self-replicating "nanobots." Eric Drexler, a pioneer in nanotech, fears that synthetic pathogens could someday drift across the planet like pollen and destroy the biosphere.

Here at the Who Knew? desk we've long since stopped sleeping at night. We just cower, 24-7-365. But we also try to remind ourselves that people have warned of technological doom since approximately the invention of the wheel. ("Everyone will go too fast and crash!")

No one can ever know precisely how technology will be used. Guglielmo Marconi thought the radio would be a tool for ship-to-shore communication. Inventors always imagine technology being put to a high-minded, serious use, but people often end up exploiting it for their personal needs, even—egad—their amusement. Technology, when fully mature, is often just a toy.

So it will be interesting to see what happens with a gizmo many technology-watchers predict will end up on people's desktops in the future, the digital fabricator—or "fabber."

Industrial fabbers already exist, making small, three-dimensional objects with complex shapes—car parts and replicas of human bones, for example—from digital models. Neil Gershenfeld, director of MIT's Center for Bits and Atoms, says that with a personal fabricator you could make your own cell phone, your own clock radio, even a computer. It would be analogous to a printer. You'd design something on your desktop computer, hit "Print" (or "Fab"), and out would pop your new creation. "It's like taking the tools of the factory and putting them in your own home," Gershenfeld says.

Physicist Freeman Dyson thinks that people might someday combine biotech and fabbers to create new life-forms, like flowers, or even very unusual pets. "You could imagine growing furniture if you could persuade a tree to grow in the right shape," Dyson says. "It's the same thing that happened with computing. The computer was originally intended only for serious, practical applications."

Dyson works at the Institute for Advanced Study, in Princeton, and remembers the early, truck-size computer built there in the 1940s and '50s. It was designed to study the weather and the processes within nuclear explosions. Important things. Practical things.

No one envisioned all that genius winding up inside a Game Boy.

—Joel Achenbach
WASHINGTON POST STAFF WRITER

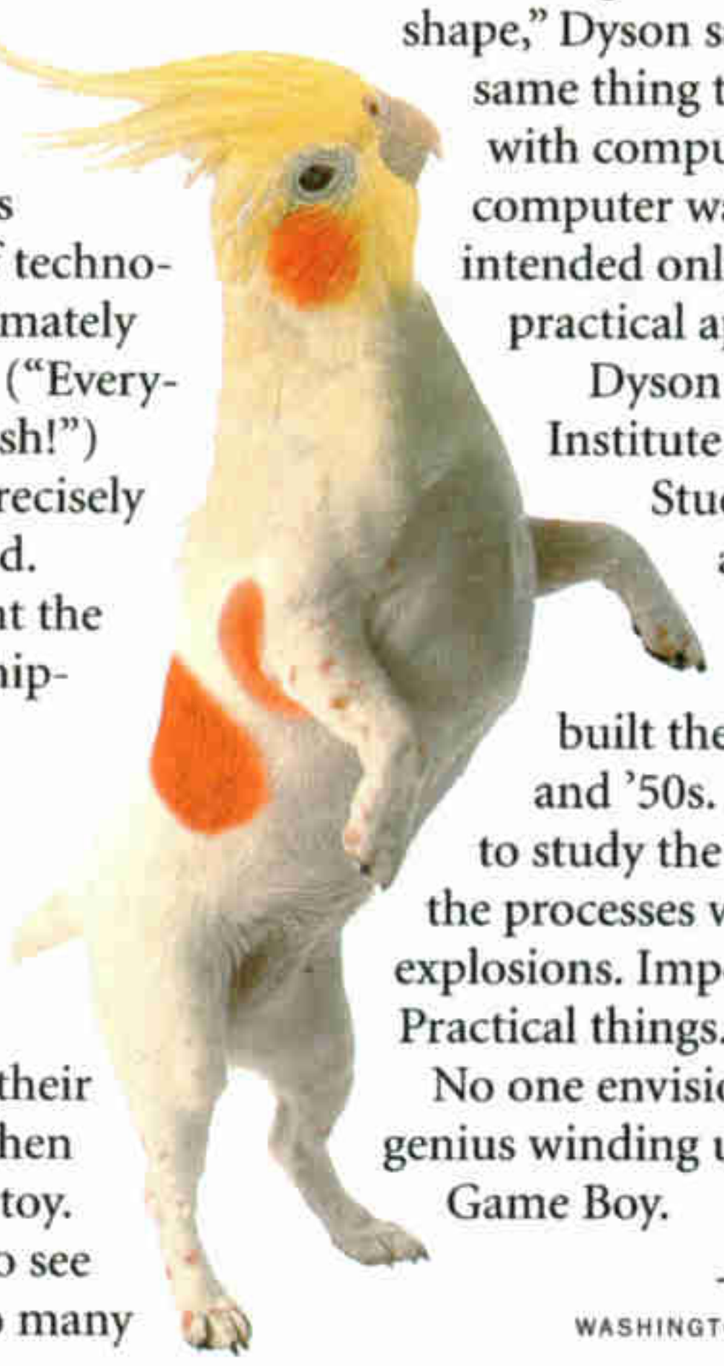


PHOTO ILLUSTRATION BY CARY WOLINSKY AND DAVID DERANIAN

IT MATTERS

New technologies can also make life *less* scary.

A doctor friend told Gavriel Iddan stories of patients miserable with unexplained abdominal pain. Moved, the Israeli engineer spent ten years developing a capsule endoscope—packing a video camera, battery, light, and wireless transmitter into a device roughly the size of a big vitamin pill. Now instead of enduring exploratory surgery or other invasive tests, patients can swallow Iddan's device, which moves painlessly along the gastrointestinal tract and captures images of the entire length of the small intestine. They can go home, drive, or even work during the six to eight hours the process lasts. Making diagnosis less frightening matters: Many people suffer untreated, afraid that the tests needed to figure out what's hurting them will hurt even more.

—Lynne Warren

WEBSITE EXCLUSIVE

Learn more about strange new technologies and find links to Joel Achenbach's work at **nationalgeographic.com/ngm/resources/0307.**

Fifty years after the Korean War ended in an uneasy truce, two of the world's most lethal armies face off across the cease-fire line. If war erupts again between the two Koreas, it will likely begin here.

KOREA'S DANGEROUS DIVIDE

DMZ

FIRING LINE

Scanning for infiltrators from North Korea, South Korean soldiers defend the Demilitarized Zone, where escalating tensions keep troops on high alert.

BARRICADE

A glaring reminder that the two Koreas remain officially at war, a ten-foot-high barbed-wire fence marches along the southern side of the DMZ. Both nations maintain 148-mile-long barriers to protect their borders at the DMZ, which runs north of the 38th parallel. The sign flashes patriotic slogans in a bid to demoralize North Korean border guards.

BY TOM O'NEILL NATIONAL GEOGRAPHIC SENIOR WRITER
PHOTOGRAPHS BY MICHAEL YAMASHITA

Day eighteen thousand, give or take a few, of the cease-fire between South and North Korea begins like most other days: Soldiers are preparing for war.

In the bitter cold of pre-dawn darkness, 15 South Korean infantrymen huddle together on a road outside a sleeping farm village and streak their faces with camouflage paint.

They snap magazines of live ammunition into their M4 assault rifles. With the wind comes a faint strain of martial music, as if from a ghostly parade, carrying from huge speakers mounted across the border in North Korea. At a hand signal from the platoon leader, the soldiers noiselessly line up and then disperse, melting into the surrounding blackness.

Their mission is to patrol a short stretch of the Demilitarized Zone (DMZ), the contentious no-man's-land that has divided the two Koreas for 50 years. The bright lights of Seoul, the South Korean capital, burn less than 35 miles away, but here in the fenced-off, land-mined, guard-towered DMZ, the only reality is a shadowy cat-and-mouse game played between soldiers of warring armies. Every 15 minutes the radioman murmurs the platoon's position back to the command post: a road, a rice field dike, now the border itself.

As the platoon approaches a North Korean guard tower, the leader signals his men to stay alert. If the patrol is particularly lucky, a North Korean soldier will recklessly dash through the brush and offer to defect with state secrets. If it is particularly unlucky, the North Koreans will open fire. That would be unlucky for all of us: In a worst-case scenario, Korea's uneasy peace could shatter, spilling war across the peninsula, with millions killed, and then possibly on to China, Japan, and beyond, pushing the world toward possible nuclear war.

Apocalyptic thoughts come easy here. In a world full of scary places—Kashmir, Chechnya, the West Bank—the DMZ is perhaps the scariest of all, considering the massive firepower deployed on both sides and the brinkmanship practiced by the rival camps. All along the 148-mile truce line that bisects the Korean peninsula, hundreds of thousands of well-trained troops from two of the world's largest armies (plus more than half of the 37,000 United States troops stationed in South Korea) stand ready to fight, trained by their commanders to hate their ideological opposites and never to let their defenses down.

This state of emergency has persisted since July 27, 1953, when an armistice agreement halted the vicious fighting of the three-year-old Korean War. The origins of the conflict go back to the end of World War II, when the peninsula was split at the 38th parallel by the Soviet Union and the United States as the Allies drove Japan out of Korea. With the tacit consent of its Soviet patron, North Korea launched a surprise, tank-led invasion across the line on June 25, 1950, seeking to impose communist rule throughout the peninsula. China, another freshly minted communist power, entered the war in October, sending waves of soldiers into North Korea when UN forces threatened to overrun the Yalu River on the Chinese border. By 1953 almost 900,000 soldiers had died—and more than two million civilians had been killed or wounded—as the South Korean military, joined by United Nations troops composed mostly of American units, battled the forces of North Korea and China to a standstill.

The end of fighting did not bring an end to hostilities. To separate enemies straining at their

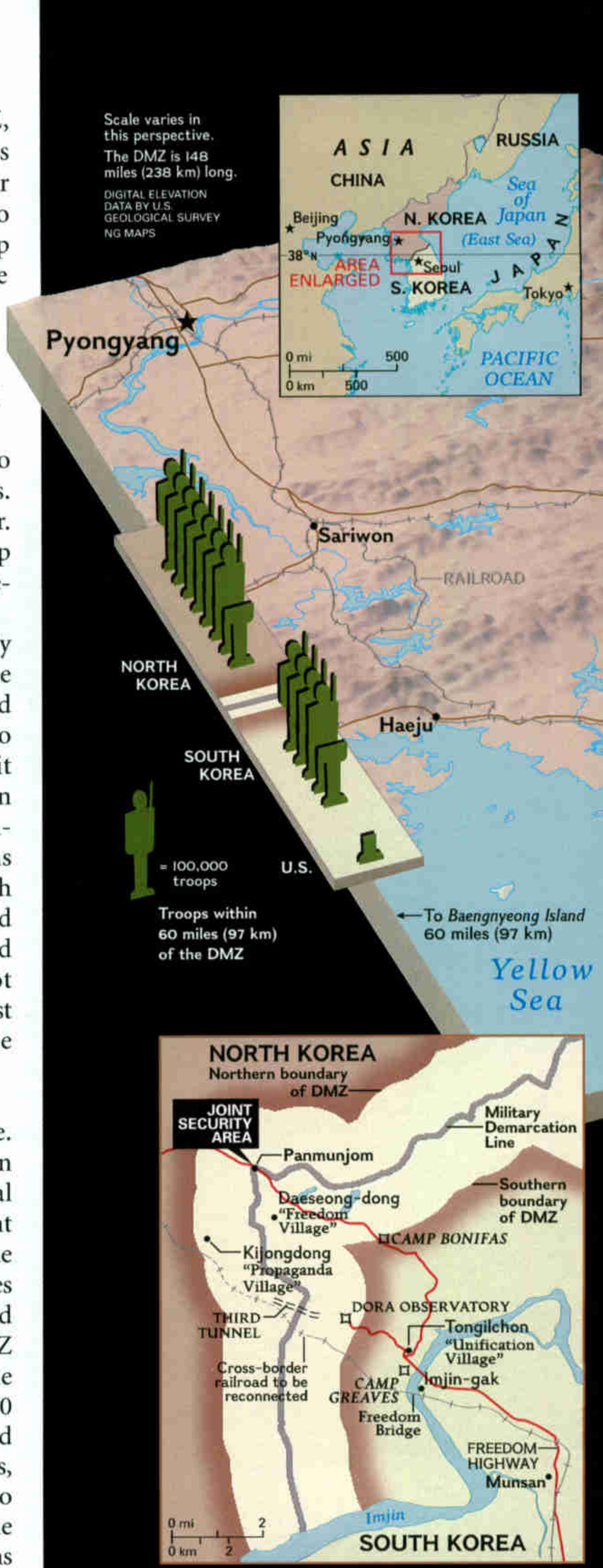
IF LOOKS COULD KILL, body counts would multiply daily at Panmunjom, the one place in the DMZ where soldiers routinely come eye to eye with their enemies. A North Korean sentry (above) shows his war face to an American officer, part of the United Nations Military Armistice Commission charged with monitoring discussions with the North. Helmeted UN guards (below) assume a martial-arts stance as they stare across the border, part of the scenery for Chinese tourists gathered on a rooftop.

leashes, the armistice carved out the DMZ, a 2.5-mile-wide swath of mostly mountainous land stretching across the peninsula near the 38th parallel (inset map, right) designed to serve as a buffer zone, off-limits to large troop concentrations and to heavy weaponry like tanks and artillery. Straight down its center was drawn the political border, called the Military Demarcation Line (MDL). Then as now, anyone trying to cross the MDL would likely be shot.

To this day, South Korea and North Korea do not recognize each other as sovereign nations. In fact the two Koreas are officially still at war. And often they act like it, keeping tensions sharp as a blade throughout the peninsula and especially along the DMZ.

Recently things have grown dramatically worse. Confronted with U.S. intelligence, the North Korean government last fall suggested that it was secretly enriching uranium to produce nuclear weapons. Early this year it withdrew from the nuclear Nonproliferation Treaty and moved to reactivate a plutonium-reprocessing facility, also to produce weapons material. And then in April, during talks with U.S. officials in Beijing, North Korea asserted that it already possessed nuclear weapons. Did these developments alarm the troops? "Not really," shrugs an American officer stationed just outside the DMZ. "We can't ratchet up the security any higher than it already is."

Just getting to the DMZ is a challenge. To join the South Korean pre-dawn patrol, I had to pass through several military checkpoints. One checkpoint guards an entrance to the Civilian Control Zone (CCZ), a high-security belt three to twelve miles wide that borders the length of the Demilitarized Zone. Another checkpoint guards the DMZ itself, right outside Camp Bonifas, one of the westernmost bases along the front line. The 600 South Korean and American troops stationed there provide protection to government officials, military officers, and other guests who come to Panmunjom, a neutral meeting place inside the DMZ. The troops, known as the United Nations Command Security Battalion, also serve as a thin first line of defense against a North Korean attack. "Some call us a speed bump," Capt. Brian Davis, my escort, says matter-of-factly.



A 1953 cease-fire pact signed at Panmunjom created the Demilitarized Zone, a 2.5-mile-wide buffer strip off-limits to heavy weaponry.

Wonsan
Taebaek Mountains
Oknyudong Valley
Kosong
Cross-border road opened Feb. 2003
UNIFICATION OBSERVATORY
Mt. Kumgang
5,374 ft 1,638 m
FOURTH TUNNEL
Sokcho
Mount Seorak
5,604 ft
1,708 m
NORTH KOREA
Three tunnels dug by North Korean infiltrators were discovered in the 1970s. A fourth was found in 1990.
Bukhan
SECOND TUNNEL
Hwacheon
CHEORWON HABITAT FOR MIGRATORY BIRDS (proposed)
Cheorwon
Military Demarcation Line
Demilitarized Zone
TYPHOON OBSERVATORY
Chuncheon
CAMP PAGE
Civilian Control Zone
FIRST TUNNEL
Dongducheon
CAMP CASEY
SOUTH KOREA
THIRD TUNNEL
Kaesong
Panmunjom
Munsan
Uijeongbu
CAMP RED CLOUD
RAILROAD
AREA ENLARGED AT LOWER LEFT
ODUSAN UNIFICATION OBSERVATORY
Han
GIMPO INTL. AIRPORT
Seoul
Incheon
INCHEON INTERNATIONAL AIRPORT
North

HOSTILE GROUND

Though soldiers guarding the DMZ (below) carry only handguns and rifles, the armies massed on either side of it hold enough firepower to raze the peninsula. Equipped with chemical, biological, and possibly nuclear weapons, the North has targeted Seoul, South Korea's capital, with hundreds of artillery pieces. South Korean and U.S. forces—with superior air and tank power—train constantly to repel an attack.

SEA FRONT

Near a South Korean watchtower, a villager harvests oysters from spiked beach fortifications on Baengnyeong Island in the Yellow Sea. Last year a clash between North and South Korean patrol boats left six dead nearby. Border skirmishes have claimed 1,373 lives since 1953.

"But if an invasion happens, we'll defend the DMZ and evacuate noncombatants."

Cleared to enter the DMZ and join the patrol, I climb into a Humvee, the bulky, all-terrain vehicle of the U.S. military. As we rumble northward through the dark with the headlights off, Captain Davis hands me a pair of $3,600 electronic night-vision goggles, standard issue for the forward troops.

In the eerie green glow of the goggles, I see the DMZ fence loom up like a jungle wall—a ten-foot-tall chain-link barrier with a canopy of coiled razor wire. A rock-hard embankment, erected to stop onrushing tanks, edges the fence on the other side. Beyond that the ground is seeded with mines. Watchtowers crop up every hundred yards or so. Except for the areas where steep terrain makes man-made obstacles unnecessary, this bristly fence walls the peninsula into two irreconcilable halves.

We drive through a gate in the fence, crossing into the DMZ, and soon we sight the platoon as it prepares to set out on patrol. I quickly apply camouflage paint to my face, take a place in the soldiers' line, and begin walking. An hour into the patrol the sky begins to lighten, causing the soldiers to crouch down and switch off their goggles.

It is a vulnerable time, these moments dividing night from day, and the soldiers wait in their defensive posture for a couple of minutes until their eyes readjust. We are within sight of the tightly clustered farmhouses in the hamlet of Daeseong-dong, the only South Korean settlement allowed to exist inside the DMZ. No lights shine in the windows. Daeseong-dong's 225 residents live under a strict curfew: off the streets by eleven, confined until dawn.

"Look, there's the enemy," a soldier in front of me says, motioning his head toward a squat concrete guard tower rising up across the MDL less than 50 yards from us. North Korean soldiers in brown uniforms press against its windows, squinting through binoculars and firing off photographs as if we're some kind of wildlife attraction.

"It's OK; we want them to see us," mutters Captain Davis. "These patrols say to North Korea: 'We're here, we're armed, and we're not afraid of you.'"

In the early light we can make out Kijongdong, North Korea's only DMZ village, an orderly collection of buildings fronted by a flagpole 52 stories high, the tallest in the world. A strong, cold wind, compliments of Siberia, barely manages to ripple the huge 600-pound red, white, and blue North Korean flag. *Soldier of Fortune* magazine, I had been told, will pay big money for a piece of that flag.

Our patrol's in-your-face attitude is completely lost on the village: Its population is zero. The fancy-looking apartment buildings are actually flimsy movie-set facades with painted-on windows. Kijongdong, nicknamed Propaganda Village by U.S. and South Korean troops, was built in the 1950s to lure defectors to cross over to the good life in North Korea. So far there have been no takers.

As the sun cracks the horizon, ragged formations of geese and ducks begin to pass noisily above us and swoop down on the fields. The soldiers don't appear to notice. Grimly, silently, they finish the patrol.

The truce has survived another night in the DMZ, and morning brings a sense of peace. But don't be fooled by the quiet, cautions Maj. Kim Bong Su, a senior Korean officer back at Bonifas. "The North Koreans are the same blood as us, but they are the enemy. They always have a gun pointed at my soldiers' hearts."

IT'S A MAN'S WORLD in the remote military camps along the DMZ. At a mountain post South Korean conscripts (above) spend free time building their body armor—and playing Ping-Pong. A typical day's training includes a bout of hand-to-hand combat (below) in a martial-arts drill. For happy hour at Camp Bonifas (left), American officers let off steam by burning wood scraps, drinking beer, and telling war stories. Land mines occasionally explode in the distance, set off by some unlucky deer.

COMBAT TOUGH

Smoke bombs and the sounds of artillery and sniper fire simulate battle as medics practice evacuating a soldier under barbed wire. Says a U.S. officer: "We train on the ground we'll fight on. And it doesn't take two days to get ready." If called upon, he says, "we'll fight tonight."

My first few hours in the DMZ schools me in how the military views the situation: It's good guys versus bad guys, and everyone's trigger finger is itchy. But just as Propaganda Village is not what it appears, the professed state of war along the DMZ at times also seems weirdly unreal, as if the soldiers are actors at a historical theme park—call it WarLand—in a disconnect especially noticeable when civilian life intrudes. Two hours after the South Korean platoon retires to its barracks, tourist buses stream onto the base, delivering giddy visitors eager to buy pieces of DMZ barbed wire strung on plaques and caps emblazoned with the Bonifas motto, "In Front of Them All."

Farmers from Daeseong-dong drift into the rice fields, ignoring their armed escorts as they climb onto threshing machines to resume the harvest. Only descendants of the village's prewar residents are allowed with their families to live in Daeseong-dong. That's where I meet Kim Ok Ja, standing on the edge of a field in a heavy quilted jacket and muddy rubber boots. She first came to Daeseong-dong as a bride, introduced to her husband through a matchmaker. "When I moved here in 1972, I was scared to live so close to North Korea," Mrs. Kim says, watching her husband maneuver the thresher through a field. "I guess I hadn't realized that this was a front line. But I did know that my husband was a good farmer."

A good and affluent farmer. Because of the relatively large farms (roughly 22 acres) and because residents don't pay taxes, Daeseong-dong's farmers earn an average of $53,600 a year, more than twice what rice growers make elsewhere in South Korea. As an added bonus, village boys are excused from military service, mandatory for other Korean males. There's a catch, of course: the nightly curfew, the armed chaperones, and the sporadic threats posed by North Korean infiltrators.

Inside his one-story farmhouse, with radishes and peppers drying on the floor, Kim Kyong Min tells me how a few years back a North Korean platoon kidnapped his mother and brother while they were collecting acorns. They were held for four nights and then released. "We don't know why the soldiers took them," Mr. Kim says. "Thankfully my mother was treated well."

Mr. Kim, a native of Daeseong-dong, betrays no hard feelings about the abduction. He also shrugs off the barrage of music and sloganeering from speakers in nearby North Korea. "I don't even notice it anymore," he laughs. "Let's see what they're saying." He stares into space, listening to the voice coming through his walls. "It says, 'This is paradise. Come over so you can have a good meal of rice.'" He smiles and pours a cup of tea.

Meanwhile in nearby Seoul, a dense high-rise city of ten million, no one, I wager, is staying home this morning out of fear of the 500 North Korean artillery pieces aimed at the city. In fact, last December South Koreans elected as president Roh Moo-hyun, a former labor lawyer who suggested in his campaign that the United States, with its in-country troops and the Bush Administration's "axis of evil" rhetoric, was pushing the two Koreas further apart. Roh's election signaled that many South Koreans want to make up with what they see as an eccentric, gun-crazy, but essentially harmless relative.

Sixteen miles south of the DMZ, inside a bunker with 600 tons of concrete overhead, Capt. Bill Brockman of the U.S. Second Infantry Division is doing a good job of scaring his audience about what lies north of the border. Captain Brockman, dressed in battle fatigues, has invited members of the press to the war room at Camp

LIVING IN HARM'S WAY barely ruffles the routines of Chun Jong Sam and his family (above), residents of Daeseong-dong, South Korea's only village inside the DMZ. The 225 inhabitants learn to live with an 11 p.m. curfew—and with armed guards in the rice fields (below). In the distance rises North Korea's DMZ "town" called Propaganda Village, a facade built to feign prosperity. On South Korean highways, camouflaged towers called tank traps (left) are wired to explode and block the advance of North Korean tanks.

Red Cloud in the town of Uijeongbu, the division headquarters, for a briefing on North Korea. "We are facing a formidable force, one of the largest militaries in the world," Captain Brockman says. "North Korea has an army of over a million soldiers, 70 percent of them deployed within 12 hours of the border. We're within range of 10,000 artillery tubes. That's enough cannon fire to put Stalin and Napoleon to shame."

For the next hour Captain Brockman describes North Korea's bag of tricks: submarines to sneak troops ashore; infiltration tunnels dug under the DMZ, four of which have been discovered so far; sleeper cells of terrorists inside South Korea; and most frightening of all, 700 to 1,000 ballistic missiles that could be armed with biological, chemical, and possibly even nuclear weapons. North Korea's threat could reach even farther, as it readies long-range missiles capable of reaching the West Coast of the United States.

The security shield has inadvertently preserved the largest piece of undeveloped land—more than 960 square miles—in South Korea.

"Our equipment will dominate theirs in a fight," Captain Brockman says, referring to the advanced weaponry of the U.S. forces and South Korea, with its 690,000 soldiers. "The big advantage the enemy has is its size. They could sweep across the border in successive waves."

Few military analysts expect North Korea to launch a full-scale attack; it would be suicidal, given that the counterattack would likely leave the country in ruins. Another Korean war would cost the lives of hundreds of thousands, if not millions, in the densely populated and economically vital South Korean territory near the DMZ. It would create millions of refugees, even without the use of weapons of mass destruction.

But even if a new Korean War seems unthinkable, what keeps DMZ troops on high alert is North Korea's greatest menace: its unpredictable leader. Kim Jong Il, a secretive and ruthless dictator, presides like a cult deity over one of the world's most closed societies. Under his leadership the country of 23 million people is collapsing economically: Experts estimate that at least 2.5 million North Koreans have died from hunger during the past decade. Yet North Korea diverts most of its scant resources into its military. Because of its inbred hostility to the outside world and because of Kim Jong Il's fear of an attack by the United States, North Korea will likely continue building its huge arsenal, the only bargaining chip it has left to play.

"We literally have a hair-trigger situation that could erupt at any time," Captain Brockman concludes from inside the bunker. "If the North Korean economy collapses, we fear that the leaders may have a use-it or lose-it mentality with their weaponry. So we wonder: Instead of crumbling quietly like East Germany, would North Korea go for broke?" The question hangs in the air like a radioactive cloud.

Despite a politically charged atmosphere of saber rattling and dire threats—and notwithstanding all the macho talk tossed around like firecrackers at military camps and guard posts—actual confrontations occur almost exclusively within the half-mile-wide enclave of Panmunjom, the DMZ's "truce village" where the opposing sides come to talk.

The most notorious incident here occurred in 1976 when North Korean troops, upset at a tree-cutting operation near one of their guard towers, bludgeoned two American officers to death with ax handles. In 1984 a 30-minute firefight erupted when North Korean soldiers crossed the line to chase after a defector. Across the DMZ as a whole, a half century of skirmishes has claimed the lives of 90 Americans, 394 South Koreans, and at least 889 North Koreans.

Also called the Joint Security Area, Panmunjom is little more than a collection of no-frills conference rooms bisected by the MDL. Here, 50 years ago, military representatives of China, North Korea, and the United Nations finalized the armistice agreement that stopped the Korean War. Today Panmunjom is the one place in the DMZ where delegates from North Korea and the UN Command force meet to discuss military, political, and logistical matters.

You might think, then, that Panmunjom is a decorous, grown-up place. Nope, says Lt. Chris Croninger of the UN Command force. "It's like a schoolyard with two bullies poking each other in the eye."

The rules of combat at Panmunjom emphasize mind games—psyching out the enemy. Each side blasts *(Continued on page 24)*

ACCIDENTAL WILDERNESS, the DMZ region hosts about 350 rare red-crowned cranes, migrants from Siberia and northeast China who arrive in winter to feed in rice fields on the Cheorwon Plain (above). Anticipating a time when troops are withdrawn, conservationists lobby for wildlife sanctuaries and peace parks along the border, unmarred by development for the past 50 years. White-crowned tourists visit the Third Tunnel (below), a North Korean infiltration route discovered in 1978 beneath the DMZ.

LONGING
Kang Jo-Kyong, who fled the North in 1947, weeps for the parents and siblings he hasn't seen or heard from since he came south. In 1953 North Korea sealed its borders, separating families. Here Kang visits Imjin-gak near the DMZ so "I can feel close to my family."


서울시

DUE NORTH

A BRIEF VISIT ABOVE THE DMZ

BY TOM O'NEILL

North Korea makes sure that tourists travel light. As the cruise ship *Hyundai Seolbongho* approached landfall on North Korea's east coast, officials winnowed my belongings. No large camera lenses or tape recorders, no newspapers, maps, or cell phones. Photographer Mike Yamashita and I were entering a country that has closed itself off from the outside world, and all guests—especially Americans—are seen as potential troublemakers.

Four hours after leaving Sokcho, South Korea, the ship with its 340 passengers docked at Kosong port. I had come for a three-day visit to Mount Kumgang, a sacred peak opened for tourism in 1998 by a North Korea desperate for foreign currency. All of us were intrigued by the chance to see a long-forbidden landscape and its people. Unfortunately the schedule confined us for much of the time in a tight bubble world created

by the Hyundai Corporation, the South Korean conglomerate that operates the trip under the eye of North Korean authorities. Within that bubble I soaked in hot baths, marveled at a troupe of North Korean acrobats, and drank Viper's Venom liquor at a tourists-only restaurant.

But I lived for the daily bus trip to the hiking paths, our only chance to witness scenes of everyday life. Through ten-foot barbed-wire fences lining the roads, we saw farmers harvesting rice by hand, men fording a river with bundles on their backs, families washing clothes in a stream. The scene was medieval.

Only once, while hiking along a gorgeous jade green river in the Oknyudong Valley, did I actually meet a North Korean, a park ranger. He aggressively questioned me about U.S. designs in Korea. "We hate America," he declared through my interpreter. "We are not evil, like your President says." His words rang in my head. Here is a nation of 23 million people who endure poverty and starvation in obedience to leaders who threaten nuclear attack as a way to win the world's respect. North Korea, glimpsed so briefly, appeared profoundly beautiful, dangerous, and sad.

Tributes to the late Kim Il Sung, the first president of North Korea, appear nearly everywhere in the Mount Kumgang area. A poem to the "Great Leader" decorates a hiking path (below). His image (bottom left) provides a political backdrop for visiting South Koreans. For a change of scenery, tourists retreat to the hot spa (top left).

YANKEE GO HOME

Ringed by police, protesters charge the gates of Camp Casey, a U.S. Army base. Anti-American rallies broke out last fall after the acquittal of U.S. soldiers involved in the traffic deaths of two schoolgirls. Some 37,000 U.S. troops are stationed in South Korea.

(Continued from page 18) opposing hillsides with patriotic music and recorded messages. A giant signboard on the North Korean side warns—in Korean characters, which few of the Americans can read—"Yankee Go Home." In one of the conference rooms North Koreans once sawed a few inches off chair legs so that their counterparts at the negotiating table would look small and silly. When North Koreans attended a meeting on another occasion with AK-47 assault rifles obviously hidden under their jackets, an armistice violation, American officers chose not to confront them. Instead the Americans took delight in jacking up the room's heat to equatorial levels just so that they could see their adversaries, unwilling to expose their weapons, squirm and sweat in their heavy clothes.

Lt. Charles Levine, a lanky South Carolinian who quit a rock band in 1998 and joined the Army, escorts me to Panmunjom to observe the mental war games. The occasion is a "body repatriation," involving the remains of four North Koreans who have washed down rivers into the south. Were they fishermen, soldiers, spies? Levine won't say.

We watch from a window as Red Cross officials from the South pass the coffins to soldiers from the North. But I hardly register the actual transfer. I can't take my eyes off the North Korean guards staring at us through the windows, close enough for us to see the red Kim Jong Il pins on their chests. Their hard stares unnerve me. "As a visitor you are not allowed to gesture at, or communicate with, the North Koreans. They want to provoke incidents," Lieutenant Levine has warned me. That doesn't stop him from shooting dark glances of his own. I also notice Major Kim, the South Korean officer I had interviewed,

toeing the Military Demarcation Line—which here is a strip of concrete between the buildings—and glaring like a bad dream at the North Korean soldiers, who glare back.

You wonder if they practice this stuff in front of a mirror. In fact, the soldiers at Panmunjom are chosen for their intimidating appearance. The South Koreans here must stand at least five feet eight, two inches taller on average than their countrymen; a black belt in martial arts is also required. The Americans assigned to Panmunjom are plucked at airports from the batches of GIs arriving from overseas, selected for height—six feet or more is preferred—and for physical bearing. The North Korean sentinels are no slouches either—ramrod straight, steely eyed, and among the best fed people in their famine-threatened country.

Outside the DMZ the big weapons come into play. The mild-sounding Civilian Control Zone, the 590-square-mile restricted area that backs up the DMZ, is bristling with tanks, attack helicopters, rocket launchers, and swarms of soldiers on maneuvers. Inside the CCZ, I sometimes feel as if I've stumbled onto a military coup in progress. Tanks rumble down the main streets of small towns; infantrymen march along country roads followed by jeeps carrying mounted machine guns; soldiers watch from foxholes. No one waves.

Troops and weaponry are concentrated in the farming country north of Seoul, both inside and out of the CCZ, in what are called the Munsan and Cheorwon invasion corridors—broad avenues of level ground that for centuries have served as attack routes to the south. The view from a Black Hawk transport helicopter reveals South Korean Army camps and weapons depots stashed in almost every draw and valley along the edges of the ancient war corridor. The 15,000 U.S. soldiers with the Second Infantry Division are also dug in here, spread out at 17 camps.

For a week U.S. Army personnel whisk photographer Mike Yamashita and me around by van, jeep, and helicopter to see the troops in dress rehearsals for war. One night I watch from a hilltop as sleek Apache helicopters with antitank missiles hover over a village and shoot targets with laser gear. On another day medics practice carrying stretchers under barbed wire as snipers fire on them.

The most intense exercise involves more than 600 soldiers from the 506th Infantry Battalion at Camp Greaves, who are conducting a mock air assault inside the CCZ. Black Hawks drop the troops at night into what the officers called "dinosaur country"—rough, up-and-down terrain—where the men have to clear the high ground of enemy forces (convincingly played by U.S. soldiers with their uniforms turned inside out). A few hours after dawn, a firefight (with blanks) erupts on a nearby hillside. Screams and curses tear through the air as a platoon leader tries to direct his men. Mortars boom and yellow clouds from smoke bombs drift over a greenhouse, flushing out a farmer, a real one, who wants to see why all hell is breaking loose.

No one pays the exasperated farmer any attention. To the soldiers, all civilians look out of place in the security zones, pieces of geography defined and controlled by the military. To the generals the terrain represents a battlefield, pure and simple. Ridgelines offer strategic points from which to shell the enemy. Valleys are invasion routes for tanks. Rivers act as barriers.

In recent times, however, new sets of eyes, civilian eyes, are looking more closely at the DMZ landscape and seeing a very different kind of place. Elderly South Koreans come on weekends to the Freedom Bridge above the Imjin River and gaze longingly across the DMZ to the nearby mountains of North Korea. They see a homeland.

The Korean War split the families of more than seven million people, many of whom fled south during the conflict to escape communist rule. Since 1953 all communication—via mail, phone, or travel—has been cut off by the North. Following a historic summit meeting in 2000, leaders of the two Koreas have allowed brief, emotional reunions for 1,200 families. Over 100,000 others have their names on waiting lists. An almost tribal desire for reunification now

permeates South Korean society, a legacy of the 13 centuries, ending in 1945, that Korea enjoyed as a unified political entity.

This longing for reunification reaches even to guard posts in the DMZ. In the central mountains, Sgt. Kim Seung Whan, his face streaked with war paint from martial-arts practice, admits that he is uneasy about the prospect of fighting North Koreans. "They are our brothers," he says, "and yet they are our enemies. It is heartbreaking."

The state of war can seem weirdly unreal, as if the soldiers are actors at a historical theme park—call it WarLand.

Entrepreneurs also eye the DMZ, scanning the lowlands on the peninsula's west and east coasts and seeing corridors for trade and tourism. Recently, both governments have cleared minefields inside the DMZ for two north-south railways closed since the war. In February the first cross-border road in 50 years opened to take South Korean tourists to visit Mount Kumgang, a cluster of sacred peaks in the North (see story on pages 22-3).

But the most compelling—and dreamy—vision belongs to conservationists. They look at the wetlands of five rivers crossing the DMZ, and at the Taebaek Mountains, a steep forested maze of 5,000-foot peaks near the east coast, and they see international peace parks, ecosystem preserves, and wildlife sanctuaries.

One of the few good things to come from Korea's 50-year standoff, the security shield erected around the DMZ and its buffer zones has inadvertently preserved the largest piece of undeveloped land—more than 960 square miles—in all of South Korea, one of the world's most densely settled countries. Most of the wilderness remains off-limits, however. To see the DMZ's star wildlife attractions—two species of rare Asian cranes that winter in the Cheorwon Basin—visitors first must apply to the military for permission.

Until tensions ease on the border, which seems a very distant prospect, the only powerful binoculars allowed inside the DMZ will belong not to bird-watchers but to soldiers manning hundreds of guard posts. On a wind-ripped mountaintop in the central DMZ, a South Korean officer hands me his field glasses so I can watch the movements of two North Korean soldiers who have emerged from their guard tower. "They don't have any heat," the officer says. "I think they came outside to get warm in the sun."

In these same mountains a force of one, an amateur wildlife biologist named Lim Sun Nam, helps me finally to see the DMZ as something other than an armed camp. For the past five years Lim, a former TV cameraman, has pursued a quixotic mission to prove the existence in South Korea of the Siberian tiger, the traditional symbol of unified Korea. Tigers officially have been absent from the southern peninsula for at least half a century. But from months of camping and hiking solo in the high country north of Hwacheon, only a few miles south of the DMZ, Lim has found provocative clues: tigerlike prints patterning the snow, tree trunks shredded by large claws, the remains of pigs and cows mauled by a powerful predator, accounts from villagers of hearing roars "like a motorcycle revving."

Lim, a short, powerful man with an Army-style flattop, hurries up a steep hillside, racing the falling sun so he can change the film and battery on a motion-sensing camera. He has positioned it close to where he found several torn-up cows. Lim does not doubt that a family of tigers lives in these mountains. His dream is to convince the military to open a 500-yard-wide gap in the DMZ fence to allow tiger populations from the north and south to meet and breed. But first he must see a tiger and take its picture.

Lim's stories about tigers and their hunting prowess spook me in the gathering dark, my nerves already frayed from living for weeks in the tense surroundings of the DMZ. As Lim camouflages his camera, a bright glow appears at the brow of the hill.

"It's a searchlight," I gasp, certain that the military has arrived on yet another nighttime maneuver. "No, friend," Lim laughs, "that's just the rising of the moon."

And suddenly I forget about the DMZ. Tonight we're in tiger country. We're in wilderness. Tonight, for only a moment, we're in a peaceful place. □

WEBSITE EXCLUSIVE

Join our DMZ forum, or watch footage of tank maneuvers, Apache helicopters, and the world's most dangerous golf course at **nationalgeographic.com/ngm/0307**.

MIXED SIGNALS of war and peace along the South Korean DMZ reveal a country torn over how to deal with its neighbor to the north. Tanks on a training mission (above) cross a river near Seoul, which North Korea has threatened to turn into a "lake of fire." Despite such tensions, both sides recently signed an agreement to reopen two railways across the border. To celebrate the pact, youngsters representing the two Koreas embrace outside the South's DMZ fence (below), a tiny step toward healing a divided land.

animal

attraction*

* It's his show, but it's her choice.

In hot pursuit, a male elk in rut chases after one of his harem gone astray. Herding resistant females comes with the territory for the elk; his reproductive future is at stake.

CERVUS ELAPHUS, JOHN MICHEL LENOIR

something in the air

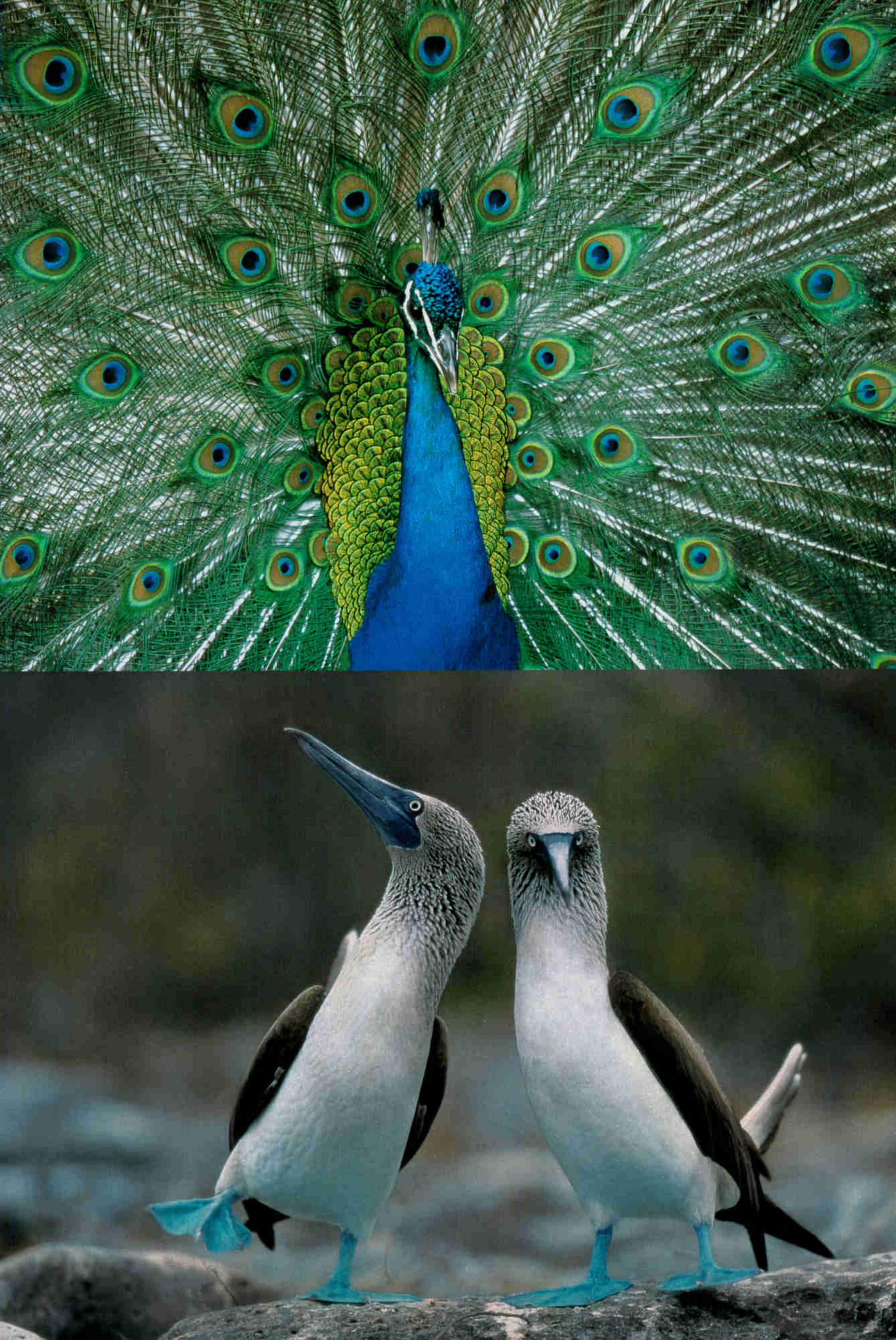
His nose knows when she's in estrus. A female lion gives off pheromones from anal glands that advertise her sexual readiness. She'll reject males that don't impress her but may also take multiple partners to nab the fittest father for her cubs. Big, plush manes seem to make an impression, as do males bold enough to fight for the lion pride.

PANTHERA LEO, GABRIELA STAEBLER, WILDLIFE PHOTOGRAPHY

winged casanovas

Black grouse males (below) spar with gusto to win mating territory. A pheasant (bottom) offers up a vigorous solo performance. A male peacock's unwieldy outfit suggests he's robust—or it may just look sexy; regardless, females prefer elaborate, heavily spotted trains. For boobies, color coordination is key. A blue-footed pair parades in webbed clown shoes.

CLOCKWISE FROM TOP LEFT: *LYRURUS TETRIX*, KONRAD WOTHE; *PAVO CRISTATUS*, INGO ARNDT; *SULA NEBOUXII*, TUI DE ROY, MINDEN PICTURES; *PHASIANUS COLCHICUS*, MANFRED DANEGGER



by Virginia Morell

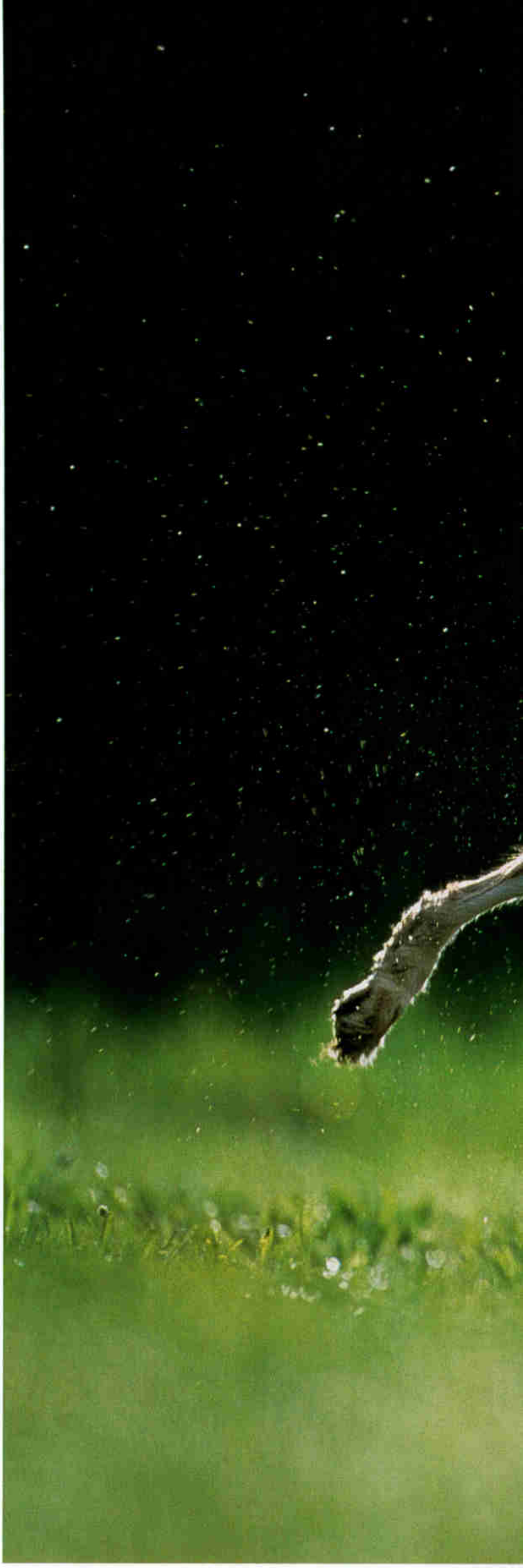
It's a blustery spring day in the Australian outback, the kind that makes you think rain must be on the way, although there hasn't been a drop in months, and the ground is brown and parched. In some animals, frogs for instance, a dry spring can slow down or stop altogether the normal, romantic inclinations that come this time of year. But the lack of rain hasn't deterred the male spotted bowerbirds.

Under old peppertrees, thornbushes, and stands of oleanders, they've built elaborate U-shaped arenas of dried grasses, 12 to 14 inches high and 12 to 20 inches long. They've decorated them with piles of sun-bleached sheep vertebrae, shiny aluminum foil, pop-tops from beer cans, shards of broken windshield glass, and little strips of red and blue plastic. The fanciest bowers feature special, seductive tidbits: a silver fork, the shoe token from a Monopoly game, old gun shell casings, red, blue, and purple glass of the deepest hues. The birds have arranged their treasures with an eye to the light—how does that bone pile look when the morning sun hits it?—and to their symmetry: silver metal hoops of unknown origin, for example, placed at equal distances from opposite ends of the bower.

Now a male can do little more than watch and wait. If he's built a good bower, then he'll succeed in life's ultimate contest and win the top prize: a female who chooses him as a mate.

"That's really what it comes down to," says Gerry Borgia, an evolutionary biologist who has studied the mating behaviors of bowerbirds for 23 years. "So you wonder sometimes when you see poorly built bowers," he says, pointing to one in disarray. "You want to say to the guy: 'Hey! This is about your reproductive success! Get moving! Straighten those straws! Find some more bones! Why be a C student?'"

Their wild breeding antics led to the phrase "mad as a March hare." Receptive for just a few hours every six weeks, female European hares nearly take flight, fending off overeager males with leaps and bounds. A doe's final pick during her tiny window of estrus is often the most persistent male of the bunch, a healthy hare refusing to give up the chase.



LEPUS EUROPAEUS, MANFRED DANEGGER

Borgia, a hefty, middle-aged man with a broad, gap-toothed smile, bends over a video camera he's placed a short distance from the bower and changes the tape. He's stationed similar cameras with microphones at 22 bowers scattered across the sheep and cattle stations near the sleepy town of Nyngan. The cameras are equipped with motion-detection sensors and record whatever the male birds—or their female visitors—do within the bowers. Later, in his University of Maryland lab, Borgia's students will review the tapes, picking out the ones that show what male bowerbirds might dream about: a female entering the straw bower, watching the male perform and sing for her, and, if she is well pleased, accepting him as a mate. Borgia isn't sentimental about this latter event, referring to it simply as a "cop"—short for copulation.

"You watch enough of these cops, and you begin to get a feel for why the female chooses one male and not another," he explains. "It's my guess that this guy isn't going to do well. I mean, that's pathetic," he says, waving his hand at the bird's puny pile of vertebrae. "And the thing is, he took over this site from an older male who died, but who had a great bower with lots of bones. And they're still here! This new guy just hasn't made the effort to move them to his bower."

Borgia shakes his head like a teacher who can't figure out why some kid who has everything handed to him on a platter would still choose to fail. "He's probably not getting any cops this year," the professor says, assigning the bird to possible evolutionary oblivion.

As if in protest, the male, a blue-jay-size bird colored beige and brown, squawks at us from a nearby eucalyptus tree. He rasps out a long series of *skraas*, then changes to the snarling, spitting sound of a cornered cat, and ends with a laughing call that sounds like a kookaburra.

"He's trying to scare us," Borgia says. "They're great imitators—cats, hawks, kids crying. They use that *skraa* call in their courtship displays too, so there must be something about it that allows females to find genetically superior males. But he's got a lot to learn about how to build a bower, one that will attract the females and get him some action."

The most successful males are about ten years

territorial tenors

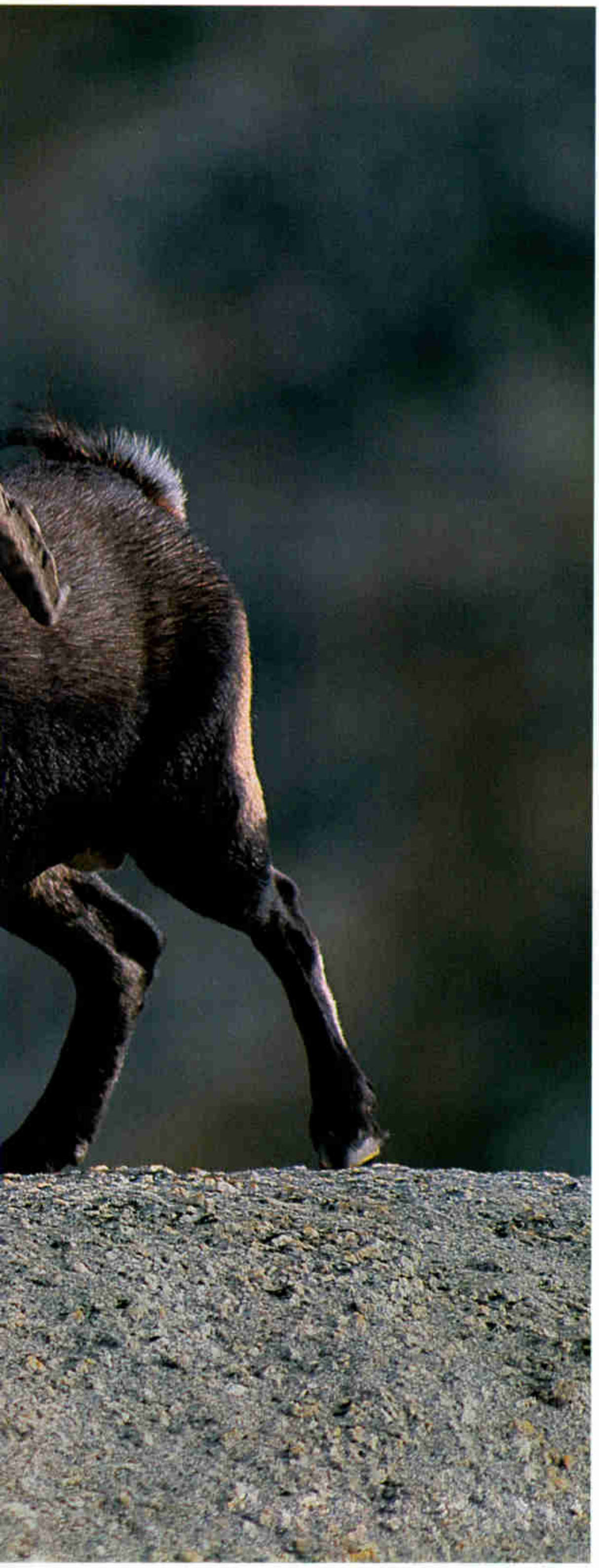
From the mouths of males come cries of warning. Red deer hold their claim to hard-won harems with bellowing roars—sometimes 3,000 a day. Their defensive calls are also music to uncommitted females, luring them to join the herd and bringing them into heat. No less effective despite the four-inch source, the shrill territorial squeal of the northern grasshopper mouse reaches ears 300 feet away.

ONYCHOMYS TORRIDUS, MICHAEL FOGDEN, BRUCE COLEMAN INC. (ABOVE); *CERVUS ELAPHUS*, JOHN CANCALOSI

"You want to say to the guy: 'Hey! This is about your

CAPRA PYRENAICA VICTORIAE, JORGE SIERRA

reproductive success! Get moving! Why be a C student?' "



old and have spent some five lonely bachelor years perfecting their skills. In this species (as with most birds), a male can't force a female to mate. Like a solo rock star, he must devise a bower, song, and dance that wows the gals. Among bowerbirds and most other animals as well, it's the females that do the choosing.

From fruit flies to elephants, females pick the male (or males) with which they want to mate. The males, in turn, compete with each other to get a female's attention, each vying to show her that he will be the best sperm donor for her babies. That is why, evolutionary biologists say, males are most often the ornamented sex. It is why the male peacock unfurls his dazzling train, why male guppies are adorned with bright orange and blue spots, why male frogs call and male canaries sing. It is even why the genitalia of many males, particularly insects, are as fancy as an Aborigine's embellished didgeridoo, with accoutrements far beyond what's required to get the job done.

"Basically, the male wants access to the female's eggs," explains William Eberhard, an evolutionary biologist at the University of Costa Rica. "And he'll do whatever it takes to please her. But it's her game; she sets the rules. And she makes the choice."

Charles Darwin was the first scientist to devise a theory of sexual selection and to recognize that females frequently select mates. He began to develop the notion while writing *On the Origin of Species*, in which he argued that the related theory of natural selection is the primary force in the evolution of all organisms.

Natural selection goes far in explaining why one individual animal survives to pass on its genes to the next generation, while another dies

Tongue flicking and horns back in a gesture of peace, a male ibex courts with a low stretch and leg raise, coaxing the female to turn so he can test her scent for signs of estrus. "He'll taste her urine, breathing it in as when one tests wine quality," says ibex ecologist Inma Alados. If his advances are tolerated, "he'll persist with chasing and mounting."

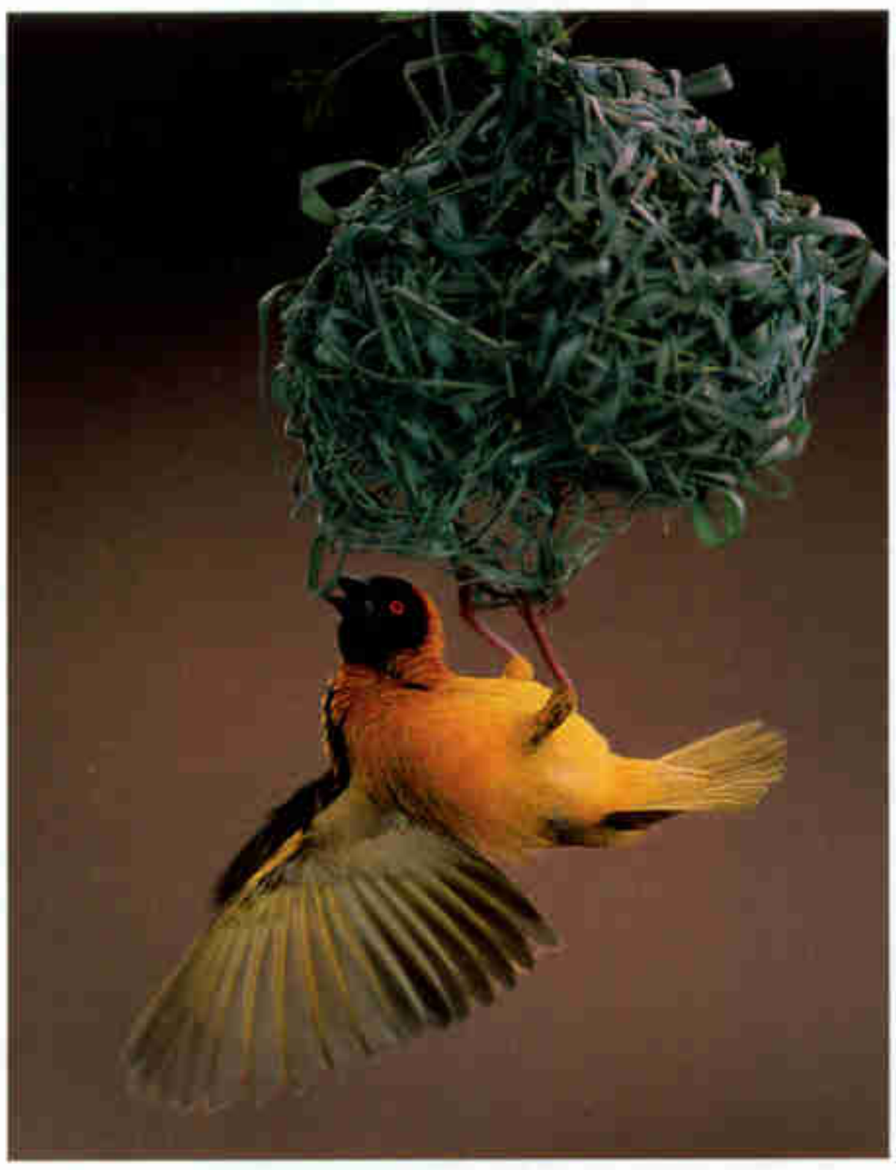
leaving no descendants. It is why female birds are often drably colored (to hide from predators when incubating their eggs), and why gazelles are built for speed (to outrun their enemies). But natural selection does not explain features that would seem to hinder an animal's survival, such as the male peacock's extravagant plumage or a male elk's heavy and unwieldy antlers. How did such unlikely traits—ones that seem to run counter to every Darwinian rule for staying alive—come about? Even Darwin struggled to find a reason, once writing to a friend, "The sight of a feather in a peacock's tail makes me sick!"

Eventually Darwin devised a solution, explaining in his 1871 book, *The Descent of Man and Selection in Relation to Sex*, that males' bright colors, baroque ornaments, and elaborate songs are the result of a process he named sexual selection. According to Darwin, sexual selection shapes species in two ways—by giving rise to competition among males for mates, and via females' decisions to mate with particular males.

Darwin's fellow evolutionists readily accepted the part of the sexual selection theory suggesting that male competition plays a role in evolution. Many males are equipped with horns and antlers or other weapons, while females are not, and it's easy to see that a male elk with a large rack would have an advantage over his rivals. He could use his antlers to defeat his competitors and mate with more females. And that would give him the chance to have more sons that would inherit his genes for big antlers and his abilities both to defeat other males and inseminate many females.

But the part of the theory suggesting that females choose mates—thus shaping male physiology and behavior and influencing a species' evolution—was immediately attacked from all sides. Another proponent of the theory of evolution, Alfred Russel Wallace, particularly despised the notion and actively lobbied against it. He argued that males were brightly colored and given to song because of their "superabundant energy" during the mating season. For Wallace, natural selection covered everything, including male competition. And he found the idea that females choose mates because they prefer a particular color or ornament ludicrous

enticing tokens



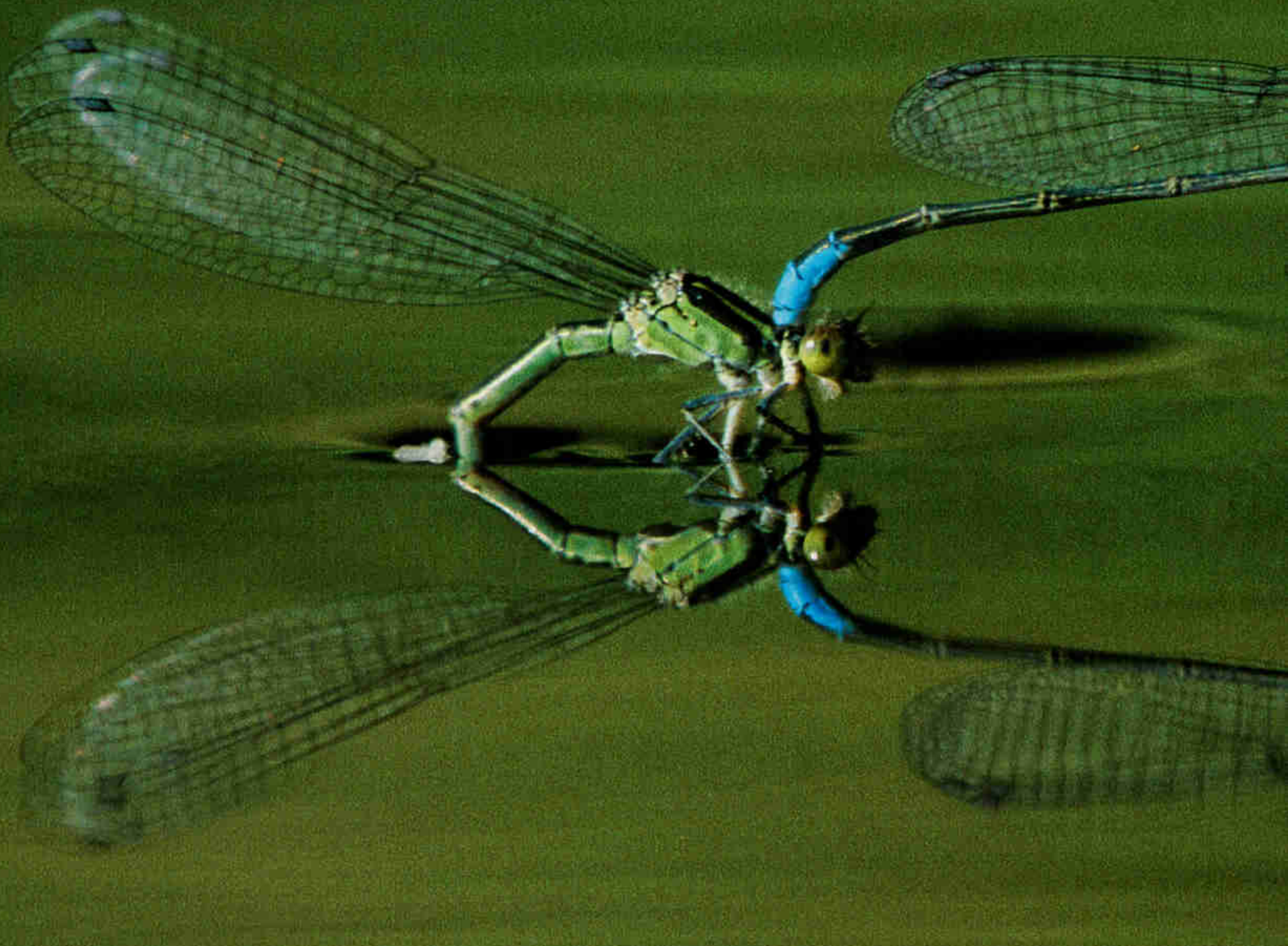
Some males must give a little to get a little. A weaverbird (above) builds a nest of greens (old brown grass won't do), then clings to his new abode shrieking and fluttering, awaiting female approval. A goshawk male brings home dinner (a jay) for his mate; she'll later initiate copulation as if rewarding his hunting prowess.

PHILETAIRUS SOCIUS, ANUP SHAH AND MANOJ SHAH (ABOVE); *ACCIPITER GENTILIS*, KARI REPONEN

protecting their interests

Post-coitus, two male damselflies stick around. Hovering overhead, they clamp on to egg-laying females to ensure their own sperm isn't snatched out and replaced by a competitor's (the damselfly penis is equipped for such a swap). Hanging on for an hour or so, the males risk becoming prey on the open water but increase their chances of passing on their genes.

ERYTHROMMA VIRIDULUM, THOMAS ENDLEIN



because it suggested a faculty for taste and discrimination that he believed to be beyond most animals. Throughout most of the 20th century Wallace's opinion prevailed, and Darwin's theory of sexual selection, with its offshoot of female choice, was largely ignored.

"Right into the 1970s people were still laughing at the idea of female choice," says Michael Ryan, an evolutionary biologist at the University of Texas in Austin. "One writer even said that all you had to do was look at our own species to see that females had no input whatsoever in mating decisions. Now, of course, we have tons of examples that show that Darwin was right: It's most often the females that choose."

Indeed, these days scientific journals are packed with papers on sexual selection and mate choice. In their search to understand how and what females choose, scientists have uncovered an entirely new world of the startling and steamy: Fruit flies that (for their tiny body size) produce some of the largest sperm in the animal kingdom; male millipedes with special legs that exist solely to rhythmically massage a female's reproductive tract, apparently a stimulation she needs before allowing him to inseminate her; a protein in a male mouse's saliva that tells a female mouse if he's Mr. Right.

And they've discovered that the females of numerous invertebrates are *equipped with* sperm storage organs, special pockets where they hold the male's fluid, perhaps assessing its quality. Scientists speculate that the females may nurture the sperm if they accept the contribution, or destroy them if not.

The biggest boost to the theory of female choice came from a highly influential paper written by evolutionist Robert Trivers in 1972. Reproduction is not an equal equation, said Trivers. Males and females invest different amounts of energy and resources into producing offspring. Males produce many relatively cheap sperm, but females make a set number of expensive eggs. So it makes sense that males compete for access to females, and that females are choosy about the male, or males, they let fertilize them.

The big question then becomes: What do the females want?

The genitalia of many males, particularly insects, are

Some researchers have speculated that a male's ornaments and vocal beguilements carry information about the quality of his genes, or his immune system, or his parenting abilities. Others have suggested that there is little information in these secondary sexual traits; they exist solely to attract the female. If she chooses a mate that other females regard as handsome, she'll produce attractive, sexy sons who are more likely themselves to be chosen as mates, and so pass on her genes.

Michael Ryan contends that although the male's trait itself—the color he displays or the sound he makes—may be arbitrary, there's definitely a reason for the female's choice. "It's generally something that the male has hit on that stimulates something in the female's neurons," says Ryan, who has subjected a variety of species to mate-choice experiments devised to get a female to tell all.

Ryan leads the way into a lab where a walnut-size female Tungara frog swollen with eggs is about to take such a test. In the wilds of the Tungara frog's native Panama, Ryan explains, the males gather in small pools to belt out two-part calls: one part a deep chuck sound and the other a higher pitched whine. The females hear potential consorts and swim to the ones

TEGENARIA DOMESTICA, SCIENCE PHOTO LIBRARY, PHOTO RESEARCHERS (TOP); SIPHONAPTERA, K. H. KJELDSEN, SCIENCE PHOTO LIBRARY, PHOTO RESEARCHERS

they choose. A selected male climbs aboard a female's back, and she carries him off to fertilize the eggs she will eject.

"The whine portion of the call identifies the species," says Ryan, in essence telling the female, "I'm a male *Physalaemus pustulosus.*" And the chuck indicates the male's size. "Bigger males make deeper chucks," he says. "Females prefer the males with the deepest chucks." Deepest chuck, biggest male, most sperm: By choosing him, a female has the best chance that all of her eggs will be fertilized.

But that's not the end of the story. A lone male with no competition may not make the chuck call; he may only make the whine and still get a female. Not until other males show up does he add his deep-throated love tone. The reason is that the love song has a mixed blessing: Female frogs aren't the only ones listening for big males. Bats, opossums, and other predators are too.

"It's a good example of the dilemma males can face," Ryan says. "If a male has to compete with other males to get a female, he must make the chuck call. But the call puts him at risk of being eaten, and thereby removed from the gene pool altogether."

Despite the dilemma of the love song, it's clear what a female Tungara frog is looking for: the biggest male, who can fertilize the most eggs. But sometimes scientists are less sure of what a male characteristic might be saying to a female. Ryan and graduate student Molly Cummings have studied a Mexican swordtail fish, *Xiphophorus multilineatus,* and found that females prefer males with shiny tails.

"We haven't figured out what that shine tells the female about the male," says Cummings, "but females seem to like the brightest males."

One thing the shine does do is sidestep the predator problem faced by male Tungara frogs. "This is what you and I see," Cummings explains, setting a photograph of a gray-black fish on a table. "And this is pretty close to what a female *X. multilineatus* sees," she says, setting a second photograph, taken under UV light, next to the first. The tail shines with silvery discs and streaks.

It turns out that swordtails can see in the UV light range, but, like us, their predators cannot. So the male swordtails seem to have evolved a less risky way of saying to their females: "Look at me. I'm the best."

as fancy as an Aborigine's embellished didgeridoo.

In other cases, researchers have a clearer idea of what male coloring tells a female. In a species of guppies named *Poecilia reticulata,* successful males generally have richly colored red-orange spots and stripes along their sides, says Greg Grether, an evolutionary biologist at the University of California, Los Angeles. "They can't make that color without eating a particular orange fruit that's desirable but fairly rare in their native streams in Trinidad," he explains. "So the orange may indicate which males are best at finding the fruit or at outcompeting other males to get to it first."

Scientists have even succeeded in deciphering the message a female reads in a male peacock's train. In a study that surely would have

Magnification reveals genital extravagance. Clockwise from top left: The male house spider stimulates and inseminates with pedipalps (claw-like frontal appendages). A bean weevil's penis abrades: Spikes hold it inside the female and also tear tissue, perhaps discouraging future matings. A bedbug's penile "hook" is a sperm-filled syringe, while a flea's exuberant organ is rigged with a gentle stimulator.

CALLOSOBRUCHUS MACULATUS (TOP), CIMICIDAE (BOTTOM), ANDREW SYRED, PHOTO RESEARCHERS

cured Darwin of his loathing for peacock feathers, biologist Marion Petrie showed that the best dads were indeed the fanciest ones. Their chicks weighed more at birth than did the others, and those same chicks were better at evading predators.

Darwin postulated that female choice not only could change the characteristics of a given species, but also lead to the creation of new species entirely. Studies of such species as the giant-sperm fruit fly, *Drosophila mojavensis,* may explain how this can happen.

In her University of Arizona laboratory in Tucson, Therese Markow uncorks a glass vial containing dozens of male fruit flies living on a bit of lab culture. She drops in a short rubber aspirator, takes aim, sucks up a few flies, and transfers them to another vial containing females.

For a few seconds the males simply sit and preen. Then one of the males moves toward a female and pulls his wing to one side, producing a soft buzzing sound.

"OK, he's starting his mating song," says Markow. "If she likes him, she'll sing back."

Like voyeurs, we watch the couple in the glass vial intently.

"Well, she doesn't like him," Markow laughs. "She's not singing back."

The male persists, now vigorously scissoring both wings; the female remains unimpressed. "Now she's singing her 'I don't want you' song," says Markow. "That poor little male; he's just singing his heart out for her."

Behind them, closer to the end of the vial, another female does scissor her wings in acceptance, and the male mounts her.

"These flies are from the same *D. mojavensis* population so that's what I would expect to see: Even though one female says no, another says yes pretty quickly," says Markow.

But when the males and females come from *D. mojavensis* populations that are geographically separate, the females of one group rarely accept the males of the other group, even though they are members of the same species. In the wild, *D. mojavensis* lives in rotting cactuses in both mainland Mexico and Baja California,

foes for love

Male zebras in territorial disputes posture and stomp, then assault with tearing bites and brutal kicks. Access to breeding females is the prize. Battles between diamondback rattlers are more dance than clash: Males snake in sync with heads high, then entwine in a muscular wrestling match until one is pinned.

CROTALUS ATROX, R. J. SMALL AND VIRGINIA SMALL, RICK POLEY PHOTOGRAPHY (ABOVE); *EQUUS QUAGGA*, ROBERT WONG

"Basically, the male wants access to the female's eggs.

separated by the Gulf of California. "The two groups can mate and produce viable offspring," says Markow. "But the females prefer not to. So I think what we're seeing is a new species in the making." The initial separation may have been triggered by the Gulf of California, a natural barrier that keeps the two populations apart, "but female choice maintains and reinforces that division," Markow explains.

Such simple preferences on the part of females —for a male of a certain color or shape, or from a particular population—are now thought to be the primary cause for the diversity of wildly decorated jumping spiders found in the Sky Island mountains near Tucson, Arizona, and for the even greater variety of cichlid fishes in Africa's Lake Malawi.

"There's no question that Darwin was right about the power of female choice," says Markow. "It can shape males *and* it can make new species."

And what is it like to be the waiting male, to be Mr. Lonely Heart? To find out, I set up a blind close to the bower of one of Borgia's spotted bowerbirds, a male the scientist says was the "big scorer" the previous year. Borgia has named each bird for the location of its bower. This top bird has built its mating arena in the shade of two old peppertrees on the Gerar Station, and so is dubbed "Gerar Pepper Bower." I nickname him "G.P."

Unlike the bower of the C student, G.P.'s is a sturdy, handsome structure, its decorations artfully arranged, its straw walls thick and symmetrical. In the center he has piled shattered bits of windshield glass, each piece about a half inch in diameter. When the sun hits them, they glitter like diamonds. He's hung some bits of metal wire and a strip of red plastic along the bower's walls and stacked a long, thick wall of sheep vertebrae

With unusual violence, a king keeps his title with a fatal, skull-crushing bite to a rival. More often, male lions chase foes away without serious injury, though invaders can pose a big threat by killing the pride's cubs (which brings females into estrus). Top males must possess extraordinary virility, as lionesses may require hundreds of bouts of mating to get pregnant.

PANTHERA LEO, MITSUAKI IWAGO

And he'll do whatever it takes. . . ."

just beyond one end. At the opposite end lies an equally large pile of clear and colored glass, sprinkled with a few shell casings and aluminum pop-tops. Other smaller piles of glass and odd pieces of aluminum foil and plastic lie scattered in a mosaic pattern around the bower, some as far away as four feet.

"Oh yes, all that is part of his display," Borgia says, when I ask about some seemingly random bits of glass. "Everything here that's not natural is part of his bower."

A male can build a straw bower in the space of a few days. Decorating it, however, takes several additional days, and getting the ornaments in the right place can take years. Spotted bowerbirds build their bowers anew each year, usually locating them close to those of the preceding mating season. And when an older bird dies, a younger one—perhaps a son or other close male relative—takes over his locality and his treasures.

"All these decorations, what the males choose and how they place them, is driven by female choice," Borgia says. "In a small way, they're like us: The male's ornaments aren't necessarily a physical part of him, but are more in the things he acquires."

Indeed, the male and female birds look very much alike—brownish and speckled with golden dots, a spray of bubble-gum-pink feathers on the back of their necks. These are usually hidden from view, but males and females unfurl them in times of aggression, and the male also fans them out when courting a female or when practicing his mating show.

I saw many such practice runs over the next four days. Sometimes G.P. perched on a branch beside his bower and rehearsed his screechy love songs, which resembled the harsh blast of steam from a cappuccino machine. Sometimes he walked the short length of his straw bower, licking every individual straw to leave behind traces of his saliva. Or he would rearrange a pop-top here, a plastic ring there, or drop one of his shell casings on the pile of glass, then cock his head to listen to the pretty *ching* it made. I imagined he would like to make that sound for a female.

Sometimes one or two other males arrived to check out the competition or to try to steal one of G.P.'s objets d'art. But he was vigorous in

slippery embrace

Cupid's got nothing on garden snails. These hermaphrodites (each is both male and female) pierce each other with calciferous arrows that carry a chemical request for sperms' safe entry. They'll even line up for a threesome. Anacondas prefer orgies: In a weeks-long session, a female in a twisting mass of perhaps ten males will allow multiple inseminations, boosting her overall reproductive success.

HELIX ASPERSA, MANFRED DANEGGER (ABOVE); *EUNECTES MURINUS*, TONY CROCETTA, BIOS

choose me

Wings outstretched and beak to the Galápagos sky, a male albatross regales an attentive female with an ancient dance. Other males may cut in to try to woo her away. She'll pick her favorite from the flock and join the ritual, bowing and flapping in reply.

DIOMEDEA, GRAHAM ROBERTSON

defense of his bower and belongings, and flew at them with beak and tongue out, claws ready to strike.

One afternoon, after another long, lonely day, G.P. picked up a bunch of green pepper berries, fluffed up his pink topnotch, and raced around and through his bower, screeching and clucking and looking rather ridiculous, like any poor soul waiting for the phone to ring. Alas, I was the only female in view.

Or maybe not. Perhaps another one—one of his own species—was watching from the safety of a nearby eucalyptus. Young females may make multiple visits to several bowers, studying them and the males, learning, Borgia thinks, how to choose. They get nothing from the male beyond his genes; he does not help to raise the chicks. Nor do females appear to mate with more than one male in one season. "She studies them and makes a choice," says Borgia, "and if she's happy, she'll return to the same male the next year."

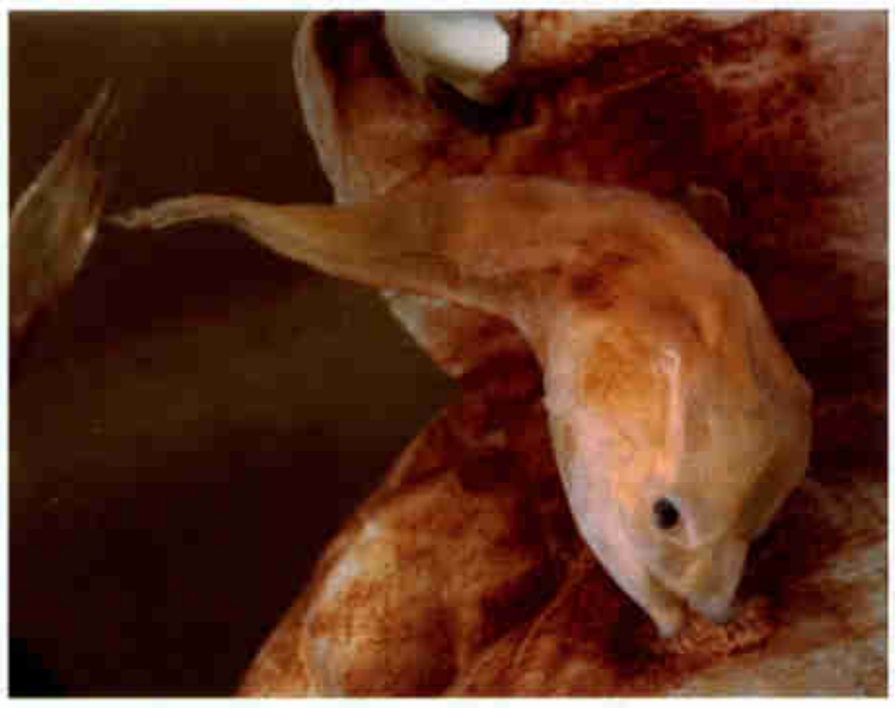
Were none of the females watching G.P. pleased enough? Or was it merely a slow period in the season? The wind blew steadily most afternoons, and G.P. often flew away when it started to kick up, apparently deciding it wasn't worth his time to wait.

And then, on the fourth morning, a female appeared. She perched on the branch beside the bower for a minute, then hopped right inside. G.P. went berserk, squawking and fluffing and racing around his bower. He stopped at one end and picked up a pop-top to show her, then dropped it and did another lap around the bower. She just watched. Then she began to lower herself, ever so slightly lifting her tail, tipping her head forward. Borgia had told me that was the "choice" sign, and I held my breath.

G.P. screeched even louder and hopped toward her. And at that very instant, another male appeared. Romance gave way to a brawl, and the female flew away.

But I was sure she had made her choice. She would be back, and G.P. would get another chance to keep his genes at play in the game of life. □

stuck with him

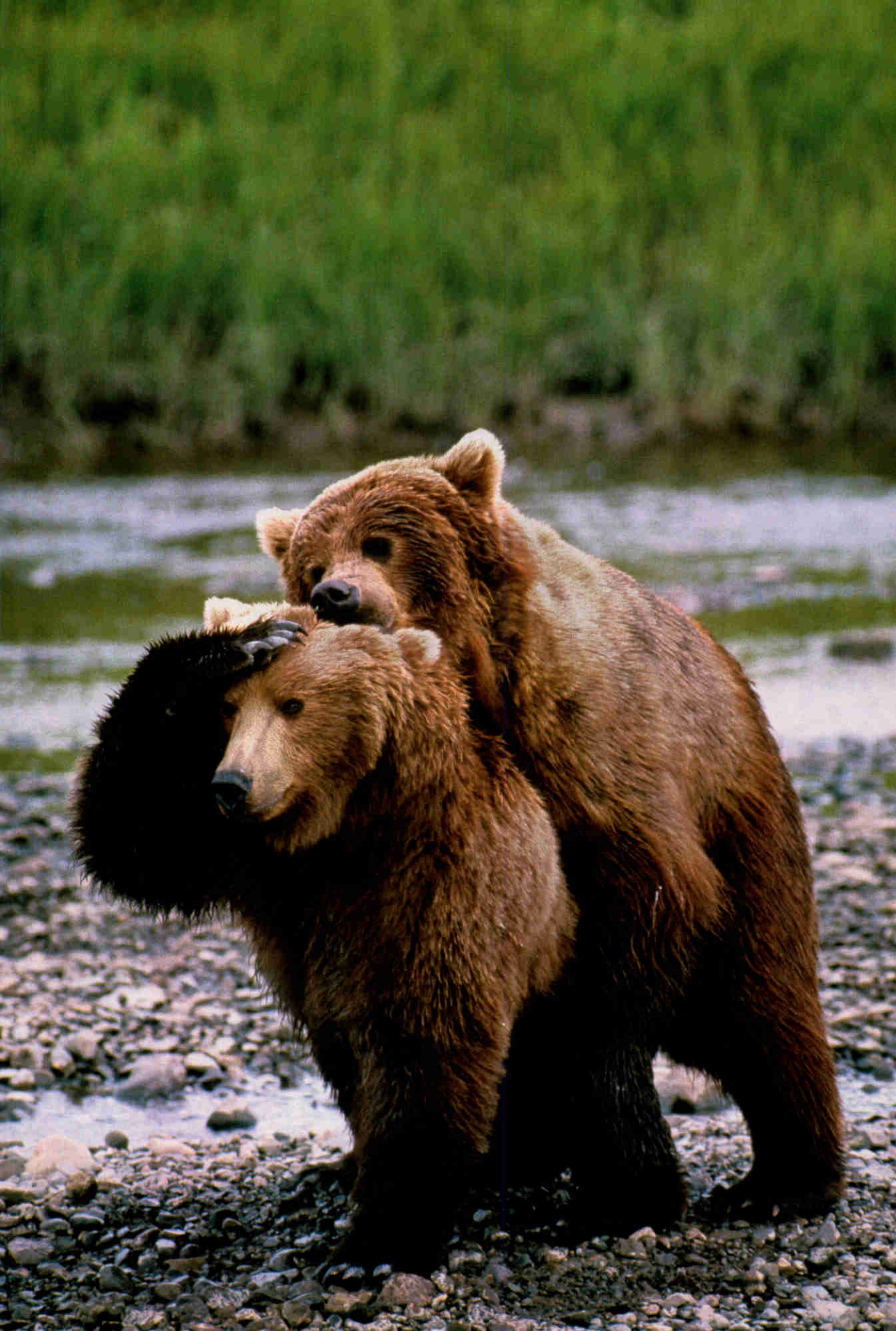


Second thoughts? It's too late, at least for devoted anglerfish. A male (above), lucking upon a mate in the deep ocean, gloms on to her much larger body for keeps, pilfering nutrients from her blood while fertilizing her eggs. So how do bears pick partners? "Size does matter," says Minnesota biologist Craig Packer, though more for male competition than female preference. In the end, whether bulky or tiny, leggy or finned, the fittest prevail.

WEBSITE EXCLUSIVE

Read the author's tales from the field, find more photographs, and check into additional resources and links at **nationalgeographic.com/ngm/0307**.

HISTRIO HISTRIO, DARLYNE A. MURAWSKI, IMAGE COLLECTION (ABOVE); *URSUS MIDDENDORFFI*, DANIEL J. COX, NATURAL EXPOSURES



THE NEW STORY OF CHINA'S ANCIENT PAST

WHILE WAR AND REVOLUTION TRANSFORMED 20TH-CENTURY CHINA, ARCHAEOLOGISTS WERE PROBING THE NATION'S ROOTS. UP CAME HARD EVIDENCE OF THE SEEMINGLY MYTHICAL SHANG DYNASTY—AND BRONZE AGE CULTURES NO ONE HAD DREAMED OF.

3,200-year-old bronze head from Sanxingdui

SANXINGDUI MUSEUM, GUANGHAN; WIDTH 7 INCHES

Raising the dead, archaeologists unearth a graveyard from the Shang dynasty, which ruled on the Yellow River plain from about 1600 to 1045 B.C. These burial plots, adjacent to a steel factory in Anyang, may soon disappear beneath a new building. But first the law requires that the site be investigated for ancient remains. In China the future is built with one eye on the past.

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Life could be brutal under Shang rule. Human skulls discovered in a pit during excavations of an early Shang capital at the modern city of Zhengzhou came from ritual human sacrifices, possibly war captives. The Shang commonly sacrificed humans to the spirits of their ancestors or to deities of nature—perhaps more than 13,000 during the last 250 years of the dynasty alone.

BY PETER HESSLER
PHOTOGRAPHS BY O. LOUIS MAZZATENTA
ART BY HONGNIAN ZHANG

When ancient cities get lost in China, they get lost in places like Anyang. The ebbs and flows of 20th-century history rushed across this part of the Yellow River plain, leaving their traces like so much jumbled driftwood. Outside of Anyang stands the tomb of warlord Yuan Shikai, who briefly seized control of the nation in the 1910s. Anyang's new downtown—white tile, blue glass—is a monument to another conqueror, the modernization of post-reform China. Wedged between the tomb and the town, there's an old airstrip that was built by Japanese imperialists during their occupation in the 1930s.

Directly beneath the Japanese airstrip, an entire city had waited for over 3,000 years to be rediscovered. When I first visited in September 2000, the underground city was poised to reappear as one of China's most significant archaeological discoveries.

But Zhichun Jing wasn't in a hurry. The 36-year-old, who has degrees in archaeology and geology from universities in China and the United States, moved to his own rhythms. He was careful, precise. He smiled easily. His open face was a work of simple geometry: round head, round cheeks, round-rimmed glasses.

"You have to look at the landscape in a dynamic way," he told me, as we walked through recently harvested stalks

Living link
to the first Shang excavations, archaeologist Shih Chang-ju (holding a 1930s photo of himself in Anyang) fled to Taiwan in 1949. Now 100, he still focuses on his work: "My job isn't done yet."

of corn that bordered the old airfield. "It might be completely different now from what it was 3,000 years ago."

Beneath our feet the earth was riddled with tiny holes, the work of a joint project of the Institute of Archaeology at the Chinese Academy of Social Sciences and the University of Minnesota, with support from the National Geographic Society. The holes were about two inches in diameter, and they had been dug with Luoyang spades—a tubular blade attached to a long pole. Each hole extended straight down for more than eight feet, deep enough to extract sediment cores containing traces of buried man-made features. At a glance, archaeologists can "read" such cores and tell whether they are standing above a buried wall, a tomb, or a rubbish pit.

Jing and the others called this site Huanbei Shang City. Since 1996, when a systematic survey revealed evidence of a buried settlement, they had been mapping it with Luoyang spades, and by 1999 they had traced the city wall, which encloses an area of nearly two square miles. The site dates from roughly the 14th century B.C., during the peak of the Shang culture that flourished on the Yellow River plain from about 1600 to 1045 B.C. Because Huanbei might be the area's first urban settlement, archaeologists see it as a rare opportunity to trace the early stages of civilization in China.

Huanbei also represents the latest chapter in the rediscovery of the Shang and other Bronze Age cultures. A hundred years ago the Shang dynasty was as lost as this ancient city, existing only in historical texts that dated from the Zhou dynasty—hundreds of years after the Shang fell. While most Chinese scholars traditionally accepted such sources, Westerners often dismissed them as mythical.

But over the course of the 20th century, the Shang steadily reappeared, the myths replaced by tangible artifacts: massive bronzes, eloquent oracle bones, burial complexes where thousands of people had been sacrificed to a hungry faith. China's recorded history starts with the Shang: Their writing is the earliest known script in East Asia. And history always seems to return to the Shang, because the search for this ancient culture has been shaped in part by the trials of modern China. Archaeologists like Jing uncover not only artifacts but also the subtle interplay between past and present.

Jing paused in the middle of the pockmarked field. He told me that in other parts of China archaeologists can recognize features on the horizon: a hill may represent a burial mound, and a ridge might reflect an old wall. But in this corner of Henan Province, river floods and redeposited loess soil have buried the past deep beneath the surface.

"We're looking at human society in three dimensions," Jing said. "It's not just the surface that matters. We had to add a third dimension: the time dimension." He squinted into the distance: cornstalks, soybean fields, parasol trees. Peasants working steadily. "You can look all around and see nothing," he continued. "But in fact this was the first city in the area. If you don't add time, you'll find nothing."

THE REDISCOVERY OF THE SHANG BEGAN WITH MALARIA. THAT, AT LEAST, IS THE LEGEND.

In 1899 a sick member of Wang Yirong's family sent out to a pharmacist for turtle plastrons—the ventral shells—that could be used to make traditional Chinese medicine. Before the shells were ground up, somebody in the family noticed that they were inscribed with strange characters that resembled written Chinese.

Ever since, historians have argued about whether the tale is true. But there's no doubt that Wang Yirong, an expert in ancient Chinese texts, became the first major collector of the inscribed shells, called oracle bones, which he purchased from pharmacies. To the average literate Chinese, the oracle bone characters were at first glance unintelligible, but classical scholars like Wang immediately recognized them as an early form of the Chinese script. Wang's scholarship came to an abrupt end in 1900, when the Boxer Uprising raged across the nation in protest of foreign occupation of Chinese territories. Wang, who was a Qing dynasty government official, reluctantly accepted the command of some of the Boxer forces. On August 14, when European, U.S., and Japanese troops entered Beijing to put down the Boxers, Wang committed suicide by drinking poison and jumping down a well.

For years after Wang's death it seemed as if the objects—which were described by pharmacists as "dragon bones"—were anything but healing. Scholars bickered over their authenticity, and dealers tried to maintain a monopoly by lying about the source, which was a small village outside Anyang called Xiaotun. Villagers in Xiaotun became so obsessed by the dragon bone trade that they engaged in fights and lawsuits. Forgeries flooded the antiquities markets in Beijing and Shanghai.

But behind the chaos, the Chinese intellectual climate was undergoing revolutionary changes that allowed the oracle bones to be viewed in a new light. After the Qing fell at the end of 1911, intellectuals began calling for China to embrace Western science and philosophy. Realizing that archaeology could provide a fresh perspective of the past, the newly established Academia Sinica sent an excavation team to Xiaotun in 1928—a project that trained a generation of Chinese archaeologists.

SOCIETY GRANT

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The earliest digs, which followed in the tracks of looters and dealers, focused on retrieving oracle bones. In the late 1920s and early 1930s, as more than 100,000 inscribed fragments came to light, the once mythical Shang dynasty became historical. But even as scholars looked back at the Shang, the inscriptions revealed that the Shang had been gazing into the future:

"In the next ten days there will be no disasters."

"If we raise 3,000 men and call upon them to attack the Gongfang, we will receive abundant assistance."

"Lady Hao's childbearing will be good."

The bones speak of war and harvest, disease and childbirth; their subjects range from the toothaches of kings to potential harm befalling the capital. They are heavy with descriptions of sacrifices, both human and animal. Natural forces are feared and respected. Foreign tribes can be allies or enemies. Statements are brief and to the point. And yet some inscriptions ring across the centuries with haunting beauty and mystery: "In the afternoon a rainbow also came out of the north and drank in the Yellow River."

"These were magical moments," said David N. Keightley of the University of California at Berkeley, who is an expert on the oracle bones. He explained the process by which Shang diviners, having made a statement about the future, used the bones to verify whether or not the event would occur. The key materials were turtle plastrons or cattle scapulas, carefully cleaned and treated (both materials provide a flat surface for writing) and thinned by drilling notches into the back. The diviners then applied a hot object until the surface cracked—a moment that, to the Shang, represented a voice from another world.

"When it cracked, the ancestors were responding to the diviner's statement," Keightley said. "The diviners wanted to capture this moment—'The ancestors say it with a crack in the bone, and we'll say it with the logographs.'"

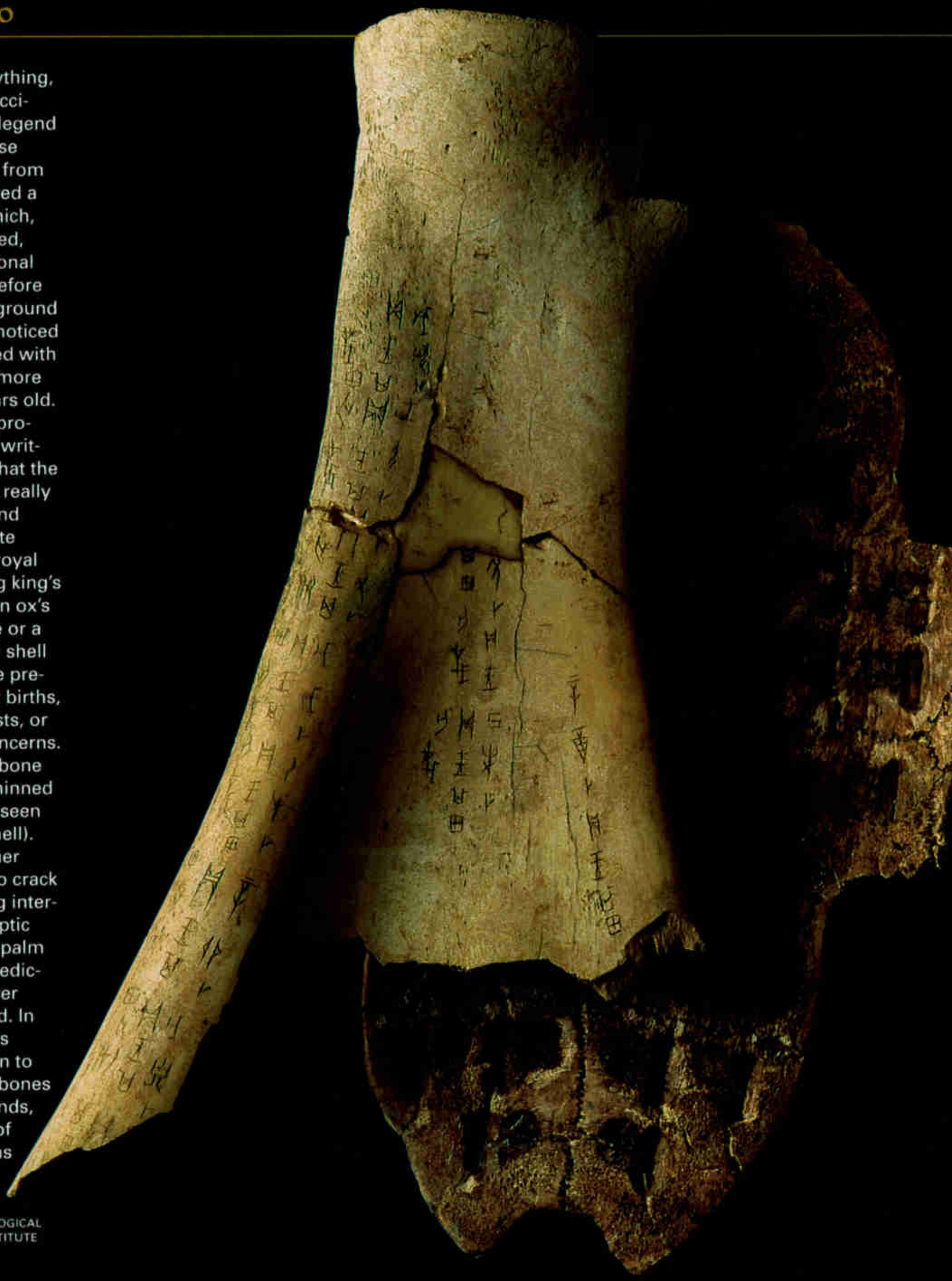
The interpretation *(Continued on page 70)*

THE CULTURAL FONT for China's 4,000-year-old civilization was long argued to be the Yellow River. Excavation of magnificent bronzes and other Shang artifacts in the early 20th century supported this tradition. But in 1986, bronzes dating from the Shang era but of a stunningly different style emerged to the southwest in the village of Sanxingdui. These and other Bronze Age finds suggest that ancient China had not one cultural center, but many.

A CENTURY OF DISCOVERY

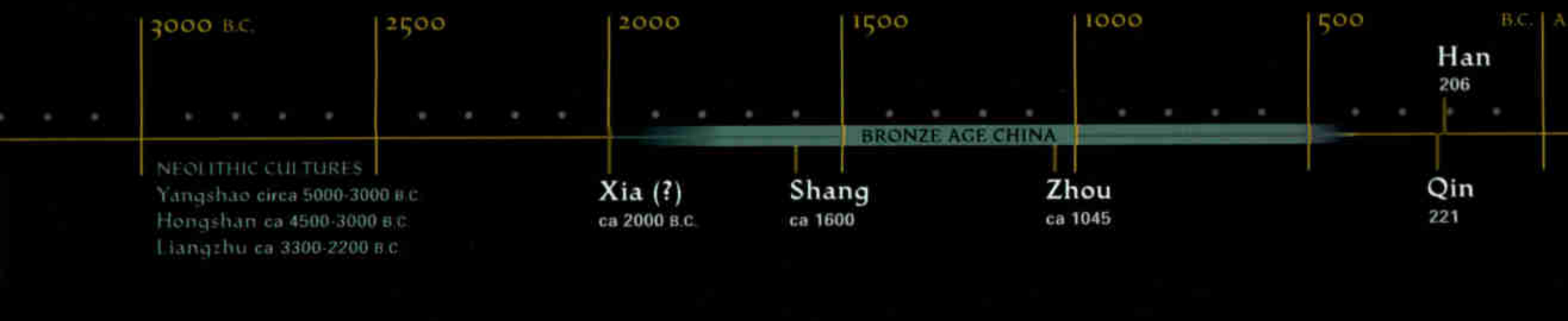
1899-1920

Oracle bones changed everything, and quite by accident. In 1899, legend has it, a Chinese man suffering from malaria acquired a turtle shell, which, when pulverized, made a traditional remedy. But before the shell was ground up, someone noticed it was engraved with inscriptions—more than 3,000 years old. Oracle bones provided the first written evidence that the Shang culture really had existed, and offered intimate details of the royal court. A Shang king's diviner used an ox's shoulder bone or a turtle's ventral shell (right) to make predictions about births, battles, harvests, or other royal concerns. The back of a bone or shell was thinned with notches (seen here on the shell). Then the diviner applied heat to crack it, and the king interpreted the cryptic fissures like a palm reader. The prediction and answer were engraved. In the early 1900s scholars began to collect oracle bones by the thousands, and catalogs of the inscriptions were soon published.



ANYANG ARCHAEOLOGICAL WORK STATION, INSTITUTE OF ARCHAEOLOGY

DYNASTIES AND REPUBLICS



1920s-1930s

After completing his Ph.D. in anthropology at Harvard University in 1923, Li Ji (below) came home to spearhead a revolution in Chinese archaeology. Between 1928 and 1937 he played a leading role in the excavation of Shang

sites at Anyang, introduced rigorous scientific standards for the excavation and classification of artifacts, and helped promote cooperation with scientists from other countries. Meanwhile, 30 miles southwest of Beijing, archaeologists were finding the fossils of Peking man. Discovered in the 1920s, *Homo erectus pekinensis* walked upright, may have used fire, and, at more than 400,000 years old, is one of mankind's early ancestors.

INSTITUTE OF HISTORY AND PHILOLOGY, ACADEMIA SINICA, TAIWAN

1940s-1950s

Chinese excavations came to a standstill during Japan's occupation of China during World War II, but flourished after the founding of the People's Republic in 1949. China's new communist leaders, who considered archaeology of national importance, established the Institute of Archaeology in 1950, subsidized the publication of monographs, and expanded training at the nation's universities. Their goal was to develop a chronology of events that validated the Marxist approach to social evolution. Neolithic people such as the Yangshao, who fashioned unusual *ping* water flasks (below), were seen as virtuous peasant craftsmen in history's prequel to Mao's communism.

GANSU PROVINCIAL MUSEUM, LANZHOU; HEIGHT 12.5 INCHES

1960s-1970s

Persecution of "subversive" intellectuals, including archaeologists, marked Mao's Cultural Revolution (1966-1976). But in 1974 excavations began of the terracotta army buried with China's first emperor, Qin Shi Huang Di of the Qin dynasty. In 1976 the tomb of Lady Hao, a consort to Shang king Wu Ding, was unearthed. It held more than 1,900 artifacts, mostly jade, bone, and bronze, including a wine vessel called a *gong* (below).

SHANGHAI MUSEUM; LENGTH 14.4 INCHES

1980s-1990s

The treasures of Sanxingdui, including a human figure (below) that stands eight-and-a-half feet tall from base to head, helped shift the center of gravity in Chinese archaeology beyond the Yellow River. Knowledge of the neolithic increased as well: Excavations in the northeast revealed numerous finds of ritual jades and the massive stone architecture of the Hongshan culture. Near Shanghai, discoveries indicate the Liangzhu culture had also mastered the jade arts.

SANXINGDUI MUSEUM

1990s-Today

China changed its antiquities law in 1991, allowing foreign scientists not only to observe but also to participate in excavations. Greater exchange of data has aided comparative study of ancient world cultures. In 1995 the national government funded a project to establish firm dates for the three earliest dynasties: Xia (still considered mythical by some scholars), Shang, and Zhou. Regional archaeology is expanding, yet faces threats from development and looting.

NGM ART

In a final drunken daze the Shang disappeared from history with more bang than whimper. The 29th and final king, Di Xin, offering a refill at far right, indulged his appetites with abandon, hosting orgiastic parties where revelers cavorted in a palace pool filled with wine. Those who displeased the king were dragged away, background, to be executed. But are these tales true? They come from the subsequen

CONSULTANT: ROBERT E. MUROWCHICK, BOSTON UNIVERSITY

Zhou and Han dynasties, whose scholars portrayed the Shang's demise as the inevitable price of vice. A Zhou axiom—the Mandate of Heaven—declares that corrupt rulers are always deposed, replaced by a new king, noble and wise. Long before scientific excavations, the area around the last Shang capital, near modern Anyang, was called Yinxu, "ruins of Yin," another name given the Shang.

ROBERT CLARK

Symbol of a divine mandate to rule, an oversize reproduction of a Shang *ding* punctuates a park in Zhengzhou. Ding cauldrons were used ritually to prepare food for royal ancestors—and they still have an aura: China hid many of its ding from Japanese invaders during World War II.

of the cracks, a task handled by the king himself, was often carved into the object, along with the original divination statement. Sometimes the court engravers later recorded whether the prediction held true. One memorable epilogue reads: "After 31 days . . . [Lady Hao] gave birth; it was not good; it was a girl."

The oracle bones refer to persons who appear in traditional historical texts, proving that the ancient tales were more than myth. Wu Ding, the 21st Shang king, is mentioned frequently by the oracle bones, as is his consort, Lady Hao (historians now believe that Wu Ding died around 1189 B.C.). The inscriptions continue down the dynastic line to Di Xin, the 29th and final Shang king, who was defeated by a neighboring culture whose leaders subsequently became known to historians as the Zhou dynasty (circa 1045 to 256 B.C.). All told, the oracle bones discovered at Xiaotun track more than 150 years at the end of the Shang era, from before 1200 B.C. to 1045 B.C.

Before the 20th century, historians had been unaware of both the elaborate Shang divination system and the ancient culture's sacrificial rituals. The 1928-1937 Xiaotun excavations uncovered thousands of graves, including nine massive tombs thought to be those of the final Shang kings. All of the big tombs had been looted centuries ago, but they still provided evidence of bloody sacrifices. One tomb complex contained 74 beheaded or otherwise mutilated skeletons. Thirty-seven horses were found in one grave. Other burials included cattle, dogs, monkeys, and birds.

The Shang spirits—ancestors as well as deities of the natural world—demanded blood on a regular basis. One scholar has calculated that the Shang sacrificed more than 13,000 humans in the last 250 years of their rule.

In the decades since the Xiaotun excavations, the Shang has often been described as a cruel dynasty that depended on slavery for its sacrifices. Yet none of the excavated oracle bones refer to the purchase of people, and slavery may be an anachronistic description. "You can't use our current standards to evaluate an ancient society," Jing explained to me.

THE VIEW OF THE SHANG HAS ALWAYS BEEN MANIPULATED BY HISTORIANS. Scholars during the Han dynasty portrayed the last Shang kings as corrupt rulers who were replaced by the

virtuous Zhou, who provided a model for the Han. Under the communist government, archaeologists emphasized Shang "slavery" because it was an essential developmental stage of the Marxist social progression that led, like some Darwinian beast rising from the muck, to feudalism, capitalism, and finally the pinnacle of communism.

This sort of political agenda often bleeds into archaeology. In the West, European archaeology first flourished during the 19th century, inspired largely by the ascendant middle classes. In part, the bourgeoisie became interested in tracing the development of ancient societies—stone to bronze to iron—because this path implicitly justified their own faith in material progress.

In early 20th-century China, there was an even more critical link between the Shang and the present, because the relics appeared just as the modern nation came under attack. In 1937, as the Japanese invasion of China pressed inland, the Academia Sinica was forced to abandon its Xiaotun site. Objects like the oracle bones symbolized China's survival. For the next decade, archaeologists became nomads, transporting their relics across a chain of southwestern Chinese cities that hadn't yet been occupied. Just before the communist revolution gained control of China in 1949, the Academia Sinica fled one final time, to Taiwan. It transported more than 1,300 crates—including the bulk of China's archaeological treasures.

From that point on, the Chinese study of the Shang was divided between the mainland and Taiwan. Until the 1980s there was no direct contact between scholars on the two sides of the Taiwan Strait. On the peripheries, foreign academics were keenly aware that theirs was an imperfect science. Keightley describes his work as "divining the Shang"—a process that, in his eyes, isn't entirely different from what was going on in the court of Wu Ding. "Just as the Shang were divining the will of their ancestors through this rather arcane process," he explained with a smile, "we're doing the same thing. We're engaged in a kind of academic divination."

On the Chinese mainland the search for the Shang all but ended in 1966 with the Cultural Revolution. Archaeological publishing was banned, and the Anyang Archaeological Work Station, which had been reestablished in 1958 by the Chinese Academy of Sciences, was shut down. Archaeologists were attacked as proponents of "feudal" days; Chen Mengjia, one of the century's most brilliant oracle bone scholars, hanged himself in a Beijing courtyard. In 1975 archaeologists at the reopened Anyang station received a political command to help the local peasants "study Dazhai."

For years nationwide propaganda campaigns had praised Dazhai, a village in Shanxi Province, as a model agricultural commune. One of the supposed Dazhai achievements involved flattening hilly terrain in order to improve farming.

"We didn't want to do it," remembered Zheng Zhenxiang, an archaeologist at Anyang. "We didn't want the ancient sites to get plowed over, so we did test excavations first. Under one hill we happened to find a huge underground tomb."

The site turned out to be Lady Hao's tomb, the first major unlooted Shang grave to be discovered by archaeologists. Finally, scholars had beaten the more than 3,000 years of Anyang tomb raiding—but now they were hamstrung by the limited resources of a country torn by political turmoil.

"We should have used pumps and wells to drain the site," Zheng explained, shaking her head. "But we couldn't afford it."

During the 1976 excavation, the 25-foot-deep pit filled with water and mud, preventing archaeologists from getting a clear picture of the tomb arrangement. It deteriorated into a salvage project—local peasants dove into the freezing muck and dragged out relics. "They drank shots of grain alcohol beforehand, because it was so cold," Zheng said.

The excavation uncovered 195 bronze vessels, of which over a hundred were marked with Lady Hao's name. There were also 271 weapons, tools, and small bronzes, as well as 755 jade objects—the most jades ever found in a Shang tomb. The pit contained 16 human skeletons, along with six dogs. Lady Hao's bronze collection weighed over 3,500 pounds.

After the excavation, a political meeting was held to criticize Lady Hao for accumulating so much wealth at the expense of the proletariat. Later in 1976, Mao Zedong died, his body put to rest in an enormous mausoleum on Tiananmen Square. The Cultural Revolution ended, and Chinese archaeologists began to dream of stability. But the future held developments that even the best bones *(Continued on page 79)*

Bewitched by bronze: A marble monster—part tiger, part human (right)—bares its teeth, but Shang bronzes are the real jaw-droppers. A *yu* basin (left) may have been used to boil water, with steam escaping from a floral stem encircled by four dragon heads. A majestic Shang *lei* (below), which once held wine, captures what archaeologist K. C. Chang has called the Shang's "extraordinary preoccupation" with bronzes. By about 1200 B.C. Chinese artisans knew how to cast large pieces, technology not achieved in the Mediterranean for another thousand years.

YU BASIN (DIAMETER 10.3 INCHES) AND MARBLE FIGURE (HEIGHT 14.8 INCHES), INSTITUTE OF HISTORY AND PHILOLOGY, ACADEMIA SINICA; LEI VESSEL (HEIGHT 20.8 INCHES), SHANGHAI MUSEUM

In the grip of death, an officer named Chang was granted a tomb filled with dagger-axes, battle-axes, and spears (bottom right); the bones of 15 people and 15 dogs; plenty of jade; and a mysterious bronze hand (above). Tales from Shang crypts in Anyang suggest that soldiers enjoyed high status in a highly militarized society, though kings still had the final word. "I pray you, assist me," the first Shang king, Tang, told his subjects prior to a battle. "If you do not obey . . . I will put your children to death with you." Perhaps modeled on a mythical monster, a patterning called *taotie*—dramatic swirls and glaring eyes—adorns a turquoise-inlay amulet (below) and many other Shang creations.

HAND (LENGTH 5 INCHES) AND SPEAR (LENGTH 10.75 INCHES), ANYANG ARCHAEOLOGICAL WORK STATION, INSTITUTE OF ARCHAEOLOGY; TAOTIE (HEIGHT 3.2 INCHES), INSTITUTE OF HISTORY AND PHILOLOGY, ACADEMIA SINICA

The great mystery of Sanxingdui concerns hundreds of artifacts that were burned or broken and then buried in two pits around 1200 B.C. Scholars speculate that creations like a spirit tree—its curved bronze arms adorned with flowers, birds, and dragons—were ritual offerings. Or perhaps an enemy was closing in, and people hid their gold masks, bronze statues, and elephant tusks rather than

CONSULTANT: ROBERT E. MUROWCHICK

urrender them. Or maybe an invading horde sacked the city. Finding these distinct treasures in Sichuan rovince, so far south of the Shang, buried the old story of China's origins. In nearby Jinsha, similar artacts came to light in 2001. "What is certain at the moment," writes Robert Bagley of Princeton University, is only that early Bronze Age China was a more complicated place than we used to suppose."

Totem to a god or king, a gilded bronze head was among more than 50 such treasures found at Sanxingdui. "Totally unprecedented," says Robert Murowchick of Boston University. "If these had not been found by archaeologists, if they just popped up at auction, you'd suspect they were fakes."

SANXINGDUI MUSEUM
HEIGHT 12.9 INCHES

(Continued from page 71) couldn't have divined: within a decade there would be a revolutionary change in the perception of the Shang-era world.

The most distinctive relics of Shang culture, along with the oracle bones, are bronze vessels. Ancient China's Bronze Age started later than in some other parts of the world—roughly 2000 B.C. in China, compared with around 3000 B.C. in southeastern Europe and the Near East. But craftsmen on the Yellow River plain quickly made up for lost time: By adding lead to the mixture of copper and tin, and developing a sophisticated casting process, they were able to produce bigger objects. "In terms of large casting, the Chinese were doing things 3,000 years ago that Europeans couldn't do until a thousand years later," said George "Rip" Rapp, a University of Minnesota at Duluth geoarchaeologist who has helped direct the Huanbei project.

The largest Anyang vessel ever discovered weighs over 1,900 pounds. But size wasn't the critical characteristic for the Shang, whose artistic style set the tone for centuries of Chinese art. Most Shang vessels are decorated with a patterning known as *taotie,* which looks like a stylized animal face. The taotie's meaning has long been debated, with the only consensus being that it carries a remarkable artistic power. There are no casual glances at a Shang bronze: The taotie dominates your gaze, drawing your attention to the swirling lines that compose the "eye"—and that mutual stare, fixed across the centuries, ends when one of you finally blinks.

Bronzes with taotie patterns have been found across much of eastern China, one reason why Shang culture has been perceived in terms of a dynasty—a political entity that, like the Qin, Han, and subsequent reigns, controlled massive territories. Throughout most of the 20th century, Chinese archaeologists applied a diffusion model to their vision of the Bronze Age: Civilization started along the Yellow River and then spread outward.

But by the 1980s the diffusion model was being challenged. Archaeologists working in the Yangtze River Valley provinces of Jiangxi and Hunan, more than 500 miles south of Anyang, uncovered massive bronzes that reflect a striking artistic independence. Local specialists argued that these were advanced independent cultures, and many questioned whether the Shang had been a dynasty in the traditional sense. "'Shang dynasty' is a very ambiguous term," Zhichun Jing told me. Searching for an analogy, Jing pointed out that every time he sees a McDonald's sign, he isn't necessarily in the United States. "A lot of people confuse the cultural elements with the political elements," he continued. "I would say that in terms of a political entity, the Shang was actually very small—no bigger than three river valleys. But the cultural influence was much bigger."

The idea that significant, non-Shang cultures had existed outside the Yellow River plain was slow to catch on. After decades of Anyang excavations, there were far more Shang relics than those of any other culture. Politics contributed to the imbalance, because government officials had a vested interest in a unified China, both past and present. And the sheer power of the Chinese script played a role, because the oracle bones are closely linked to today's writing. "The oracle bones of course see everything from the Anyang king's point of view," said Robert Bagley, a Bronze Age specialist at Princeton University who believes that the study of non-Shang cultures has been neglected. "It's like that *New Yorker* map where most of the world consists of Manhattan."

IN 1986 A PEASANT WOMAN NAMED XU WENQIU HELPED CHANGE THE MAP OF ANCIENT CHINA. A resident of Sanxingdui, a small village in Sichuan Province, Xu and her neighbors were digging clay to make bricks when a cache of carved jade pieces suddenly appeared. "The next thing I saw was everybody running away," the 50-year-old remembered with a laugh, when I visited her simple home. "They all disappeared, and so did the jade."

Archaeologists quickly took over (and military police were called in to make sure the jade reappeared). That summer a remarkable new culture came to light. Two pits contained hundreds of artifacts: elephant tusks, cowrie shells, and objects of jade, gold, and bronze. The pits, which had been buried around 1200 B.C., were roughly contemporary to Wu Ding and Lady Hao.

But Sanxingdui and Anyang are nearly 700

ROBERT CLARK

Poised atop the wall of an ancient Shang city, a woman in Zhengzhou joins a group for morning exercises, independent but part of the whole. China, too, strives to balance its own historic tensions: How did so many cultures coalesce into a single nation, and what will keep it moving as one?

miles apart, and many Sanxingdui bronzes are unlike anything else ever discovered in China. There's a unique emphasis on the human form—the pits included more than 50 heads, 20 masks, and one enormous eight-and-a-half-foot-tall statue of a man. The heads are narrow and elongated, dominated by enormous eyes. Like those of the taotie, the Sanxingdui eyes have a mesmerizing power, but a viewer instantly recognizes that he is staring into the gaze of a very different beast.

"Even the diehards who believed in the diffusion model have given up in the face of Sanxingdui," said Bagley. "Nobody is claiming that this stuff comes from Anyang."

In 2001, at a construction site in Jinsha, another city in Sichuan, workers stumbled upon a pit containing similar bronzes. But no written language has been discovered, and scholars have not found a Shang oracle bone that refers to the Sanxingdui culture. From an archaeological point of view, the pits of Sanxingdui and Jinsha remain completely isolated—in Sichuan, the next discovery of comparable wealth dates to more than a thousand years after Sanxingdui.

But the relics hint at links across ancient China. Some of the Sanxingdui jade pieces can be traced to cultures near Anyang, while a few bronze vessels are clearly imports from the middle Yangtze region, or may be imitations of that area's style. Increasingly, archaeologists view early Bronze Age China in terms of multiple centers of civilization that exchanged goods and technologies.

This model suits the political climate of post-reform China, where trade is king and regionalism often turns neighbors into rivals. In Beijing I met a lapsed archaeologist named Xu Chaolong, a Sichuan native and Sanxingdui specialist. A decade ago Xu was one of the most promising young Chinese archaeologists, but since 1998 he has worked for Kyocera Corporation, a Japanese company that produces cell phones. He told me that he had abandoned academics in part because he was frustrated by the overemphasis on Yellow River plain archaeology. In his opinion, Sanxingdui and other southern sites deserve greater attention. To prove his point, he emphasized that Sun Yat-sen, Mao Zedong, and Deng Xiaoping all hailed from the south.

"Today is a period of great change in China, both economically and politically," Xu said. "Where does this change come from? The south. Why should the south lead our economy? Because it was also this way in the past. The Yangtze wasn't some barbarian region. It was even more advanced than the Yellow River."

TIME IN CHINA—THAT EXTRA DIMENSION—TENDS TO BLUR. The past and the present are never completely separate; a single conversation can span so many disparate personalities—Lady Hao and Wu Ding; Mao Zedong and Deng Xiaoping—that they seem to be rubbing elbows. As a result, the profession of archaeology was a risky one in the 20th century. Three major oracle bone scholars committed suicide. Some archaeologists died in the mid-century wars; others were imprisoned.

Shih Chang-ju has outlived it all. At 100 years of age, he is the last of the original Xiaotun excavators. In 1936 he helped uncover the largest oracle bone pit ever found; the following year, along with the rest of the Academia Sinica, he fled from the Japanese. In 1949 he went to Taiwan, leaving behind a wife and the work fields of Anyang. He never saw either of them again.

"I was finally invited back about ten years ago," he told me. "But by then I was too old to travel."

He spoke with a strong Henan accent, and he had trouble walking. Shih himself was becoming a subject for archaeology: the Academia Sinica preserves his old Keuffel & Esser surveying scope in a glass case. But Shih still comes to work every day, and his memory is perfect—his nickname is "the living dictionary." When I visited, a notebook from 1936 was lying open on his desk. For half a century he has meticulously studied the relics and records of the old Xiaotun excavations.

His eyes lit up when I asked if he had heard about the most recent discovery.

"Huanbei City," he said instantly. "We conducted surveys there but never found the city. There was already so much for us to do at Xiaotun. They have time to research it now."

Back at Huanbei Shang City, nothing had changed in the year since my first visit. The airfield, the corn, the tiny holes—all the same. Zhichun Jing and his colleagues were using Luoyang spades to follow an underground wall.

But Tang Jigen, the 37-year-old director of the Anyang research station, was excited. He told me that early signs indicated that Huanbei might have been a Shang capital that predated the site at Xiaotun. For archaeologists, Huanbei is also significant because it was discovered during a systematic survey. Chinese archaeologists speak of "active" and "passive" excavations—the latter are discoveries that come about by chance, whether through making bricks, flattening hills, or digging a building's foundation.

"If we could, we'd concentrate on active excavations all over China," Tang said. "Then we could do it systematically, but often because of economic reasons it just isn't possible. That's starting to change, though."

Still, few people are naive enough to think that Chinese archaeology will escape entirely from modern pressures like development and politics. During the 1990s the Chinese government funded the Xia-Shang-Zhou Chronology Project, whose stated goal—establishing firm dates for these three dynasties in China's "continuous civilization"—seems at odds with the nuanced portrait of ancient China that has emerged in recent years. A number of scholars criticize the project as more nationalistic than academic.

Early scattered excavations at Huanbei were funded by the Xia-Shang-Zhou project, but the survey work has depended on foreign funding and has involved foreign specialists—cooperation that would have been impossible only a decade earlier. Once mapping is complete, excavations will follow.

I joined Jing out on the Japanese airfield. A ditch cut into the field's border had just revealed an enormous round stone that appeared to be a foundation for a Shang building. Above the stone, the earth showed traces of a wooden pillar that had rotted away centuries ago. "We've never seen anything like this before," Jing said.

He turned to an old peasant he'd known for years and asked if he knew of similar stones. "A lot of time villagers give good information," he told me. Later that fall Jing's words would prove accurate. Heeding local advice, the survey turned up a stone that was part of the largest Shang building foundation ever discovered.

Once again the flow of time in Anyang had scattered its unlikely driftwood: A Japanese airfield, a young U.S.-trained Chinese archaeologist, an old peasant with a feel for the earth. But finally the pieces made sense—a lost city coming to light. □

WEBSITE EXCLUSIVE

Curious about how Chinese names are pronounced? Why Peking became Beijing? Check out Did You Know?—and more—at **nationalgeographic.com/ngm/0307.**

a mad dash up 3 peaks in 3 countries: it's all in a

day's climb

By T. R. Reid

Photographs by Joel Sartore

"Off your bums, you pillocks," the one-armed man said. "We've got two more mountains to climb." Partly out of curiosity, but mainly because I was much more inclined just then to sit on my bum than to pull my battered body up another mountain, I stalled for time with a question: "What's a pillock?"

"You don't know the word 'pillock?'" laughed Pete Crow, the comedian on our team of climbers. "Don't you Yanks speak English?"

"A pillock is a bloke who's always faffing around," piped up Phil Barnes, a powerful man with legs like tree trunks stuffed into black British Army boots. When I looked mystified at that, Kelvin Highmore, the kindly father figure of our team, came to my rescue. "He means, you know, a stupid berk," Kelvin said. "A skiver. A wally."

By now other members of the group were throwing out their own definitions. But my lesson in British slang came to an abrupt end when Tom Perkins, our one-armed captain, pulled a glove onto his left hand with his teeth and started trotting up the rocky slope of Scafell Pike, England's highest mountain. We all scrambled to catch up. In a flash, the seven of us were off on the second leg of Great Britain's notorious Three Peaks Challenge.

At that point I did feel like a pillock, a faffer, and a genuinely stupid berk just for taking on the Three Peaks, one of the more grueling endeavors yet devised by the fiendish minds of people who climb mountains for fun. The Challenge is a demanding test of stamina, logistics, and sheer will power, but it stems from a simple geographic fact: While Britain has produced some of the world's greatest mountaineers, the country has no great mountains of its own.

British climbers regularly train on Ben Nevis, a flinty bald peak in the Scottish highlands. By official measure of the national Ordnance Survey, its summit is the highest point in Great Britain. But that's like being the longest hole on a miniature golf course. Ben Nevis rises an underwhelming 4,408 feet above the silver-gray lochs of central Scotland.

The trek from sea level to summit is not exactly a walk in the woods (for one thing, there are no trees on the Ben's stony escarpment), but

PHOTOGRAPHER'S NOTES

Just so you know: These are the worst mountain-climbing photos ever published in this magazine. I only had 24 hours to cover a team of firemen scaling three British peaks. I'm out of shape. I hate mountains. I hate hills, too, and I'm not that fond of stairs. I'm from Nebraska, which is so flat that a spilled beer doesn't go anywhere. It just waits for the sun to take it up to the sky.

JOEL SARTORE WITH RUSSELL CHADWICK

Our climbing team flashes by (left to right): Phil Barnes, Tom Perkins, Julian Parsons, Kelvin Highmore, Martyn Olden, Pete Crow. Writer T. R. Reid leads the way.

sending a veteran mountaineer up Ben Nevis is the equivalent of asking a four-star chef to order in pizza from Domino's.

To overcome this altitudinal shortfall, serious British climbers sometimes cram two or three different summits into a single day's outing. The mother of all these multi-mountain climbs is a trek with pan-Britannic sweep, taking in the highest peaks in each of the three countries that make up the island of Great Britain. That's the Three Peaks Challenge: You have to climb the tallest mountains in Scotland (Ben Nevis, 4,408 feet), in England (Scafell Pike, 3,205 feet), and in Wales (Snowdon, 3,560 feet). And you have to do them all in 24 hours.

The whole adventure involves 21 miles of hiking, 18,786 vertical feet of ascent and descent, 500 miles of driving between the peaks, and enough unprintable British slang to turn the Queen's ears blue. Some climbers are such masochists that they actually do this in the depths of winter, but the preferred time is right around the summer solstice, when the longest days of the year provide the maximum hours of daylight climbing. Indeed, Ben Nevis is so far north—roughly the same latitude as Juneau, Alaska—that twilight in early

PHOTOGRAPHER'S NOTES

Even the Scottish sheep were faster than I was. It's not like I didn't train. I switched from Cocoa Puffs to Cap'n Crunch to cut down on sugar. I ate cake doughnuts instead of glazed to limit fat. And when I learned that the guys planned to race-walk up, then run down, all three mountains, I reacted like the pro I am. I cried.


KEEP
CLEAR

summer lingers nearly until midnight. Accordingly, most Three Peakers start by climbing Ben Nevis early one evening in mid-June, then pile into cars or vans and race south overnight to top the other two mountains the next day.

To climb three mountains in three countries in one day, you need to be a little wacky. You need a mountain of equipment and food; our van was stocked with enough energy drinks and Power-Bars to feed a small nation for weeks. Most of all, though, you need a team. You need a team to deal with the logistics of long-distance travel from Scotland to England to Wales. And since misery loves company in the mountains, you need a team for encouragement, to keep you going when every sinew in your body is telling you to quit.

This team business proved a problem for me when I decided to give it a go last year: All my friends were much too sane to try the Three Peaks Challenge. So I approached Ludo Macaulay, a friendly fireman from Wiltshire who organizes an annual charity assault on the Three Peaks for the British Fire Service, with climbing teams from fire stations all over Great Britain. Ludo assigned me to the squad from Chippenham, an ancient market town on the Salisbury Plain west of Stonehenge. Officially, my group was designated Fire Brigade Team B-24. Unofficially, and more appropriately, it was known as Team Perkins.

PHOTOGRAPHER'S NOTES

Every year on their way north, the firemen stop at Blackpool's Pleasure Beach park to unwind, and to get happy before the climb. They were really happy on this caterpillar ride, because I'd called ahead to get them in for free. Then we hit the road in a white van that smelled like cheese (and not in a good way).

Team Perkins was born—although nobody realized it at the time—on August 4, 1998. A quiet summer's afternoon at the fire station was interrupted by an emergency call: A motorcycle had crashed into a highway maintenance truck on a country road outside Chippenham, and both vehicles were ablaze. The fire brigade rescue team raced to the site, sirens blaring, but was evidently too late. "We could see that the biker was gone," recalls fireman Keith Bacon. "He was burned everywhere. His right leg was basically snapped in two, and the only thing connecting the right arm to his body was his leather jacket.

"So we focused on putting the fires out, clearing the road. And then—this was 15 minutes later, maybe—I just happened to glance over at the guy on the bike. I thought to myself, Hold on. Dead men don't twitch. He must be alive. So we went over and took off his helmet. That's when we realized for the first time that this poor bloke was one of our own."

That poor bloke was Tom Perkins, a Chippenham firefighter who was then 26 years old. He lapsed into a coma after the crash and woke up a month later to find his right arm gone, his face and his remaining arm furiously blistered by fire, and his right knee so badly shattered that doctors warned he might never walk again.

"But gradually," he told me when I met him four years after the accident, "I learned to compensate for that knee by using other muscles

Climbing Great Britain's three highest mountains in under 24 hours takes preparation. The Chippenham team trained with stretches at the fire station (top left) and light lifting at the pub (left). Why not give up beer before the big race? "That might not be such a bad idea," said Julian, "but we're English."

in my leg. To strengthen them, I was up and down the steps of that hospital day and night. When I finally left the hospital, I was walking. But I needed something else to keep my muscles strong."

Tom's friends at the fire station gave him that something else. They formed a Chippenham team to enter the Three Peaks Challenge in 1999, with Tom as team leader. "We trained together for months," said Kelvin Highmore. "That first climb was the hardest thing I ever did. But whenever I thought it was too much, I looked up ahead at Tom, with his arm gone and his dodgy leg, and he was going strong. There's no question that Tom is our inspiration."

By the time I joined Team Perkins, Tom and Kelvin had put together a strong, seasoned group of six climbers, drawn partly from the fire station and partly from a local factory, plus two designated drivers, for the Three Peaks Challenge. The guys were as tough as they looked—tattoos on their arms, gold rings in their ears, and muscles everywhere. They rolled their own cigarettes while chatting casually about marathons and long-distance bike rides they had finished.

In fact, Team Perkins had only one weak link: me.

Thousands of climbers attempt the Three Peaks Challenge each year. For safety's sake, participants in the firemen's event must take at least 11 hours to drive the 500-mile route. Speeding between peaks won't help their times; early arrivals at Scafell Pike and Snowdon are made to wait for the official safe drivers' start time to begin.

Ben Nevis's summit is the highest point in Great Britain. But that's like being the longest hole on a miniature golf course.

A month before the climb, Tom called to say he was filling out the official entry forms; he needed to know my age. "Fifty-eight," I replied. This was followed by a long, pregnant silence from the other end of the phone. "Well, you're a really fit 58, right?" he finally replied.

As that exchange made clear to me, there was a yawning gap between me and the six strapping athletes on my team, some of them a quarter century younger than I was. But the group welcomed me nonetheless, particularly the gruff, amiable Kelvin, who, at 42, had been the Old Man of the team until I came along. During a planning session at the fire station, I was delighted to find that several members of Team Perkins

It's the "most beautiful of the peaks," Kelvin says of Scotland's Ben Nevis (below), though "you don't appreciate it when you go for speed." Their fast pace later slowed the team: Pete twisted an ankle and Julian strained a knee.

Some Three Peakers never manage to sleep on the jerky, bumpy ride between mountains.

Neither junk food nor health food was much help to the tired firemen after their Ben Nevis descent. Julian, Pete, Martyn, and Tom (left to right) had conquered one mountain, but they had two more peaks to go. And Pete—who, according to Julian, is "a bit of a delicate traveler"—was feeling queasy.


EMERGENCY DOOR

You need a team for encouragement, to keep you going when every sinew in your body is telling you to quit.

"Vomiting Pete" lived up to his nickname (below) as the van sped toward Scafell Pike. Other calls of nature (above) were answered outside.

took the same approach to climbing that I did—that is, constant griping.

"We're going to whinge our way to the top," said Pete Crow, using another English word I didn't know. (It means complain or whine.) "If the sun's out, we'll whinge it's too hot. If it's raining, we'll whinge it's too wet. When we finish the thing, we'll whinge our time wasn't good enough." Here was a climber after my own heart.

Having taken in a semi-elderly American, Team Perkins was equally welcoming when another Yank, Joel Sartore, was assigned to photograph our epic trek. A confirmed flatlander from Nebraska, Joel told us the highest point he'd ever reached was the eighth story of the Holiday Inn in Lincoln.

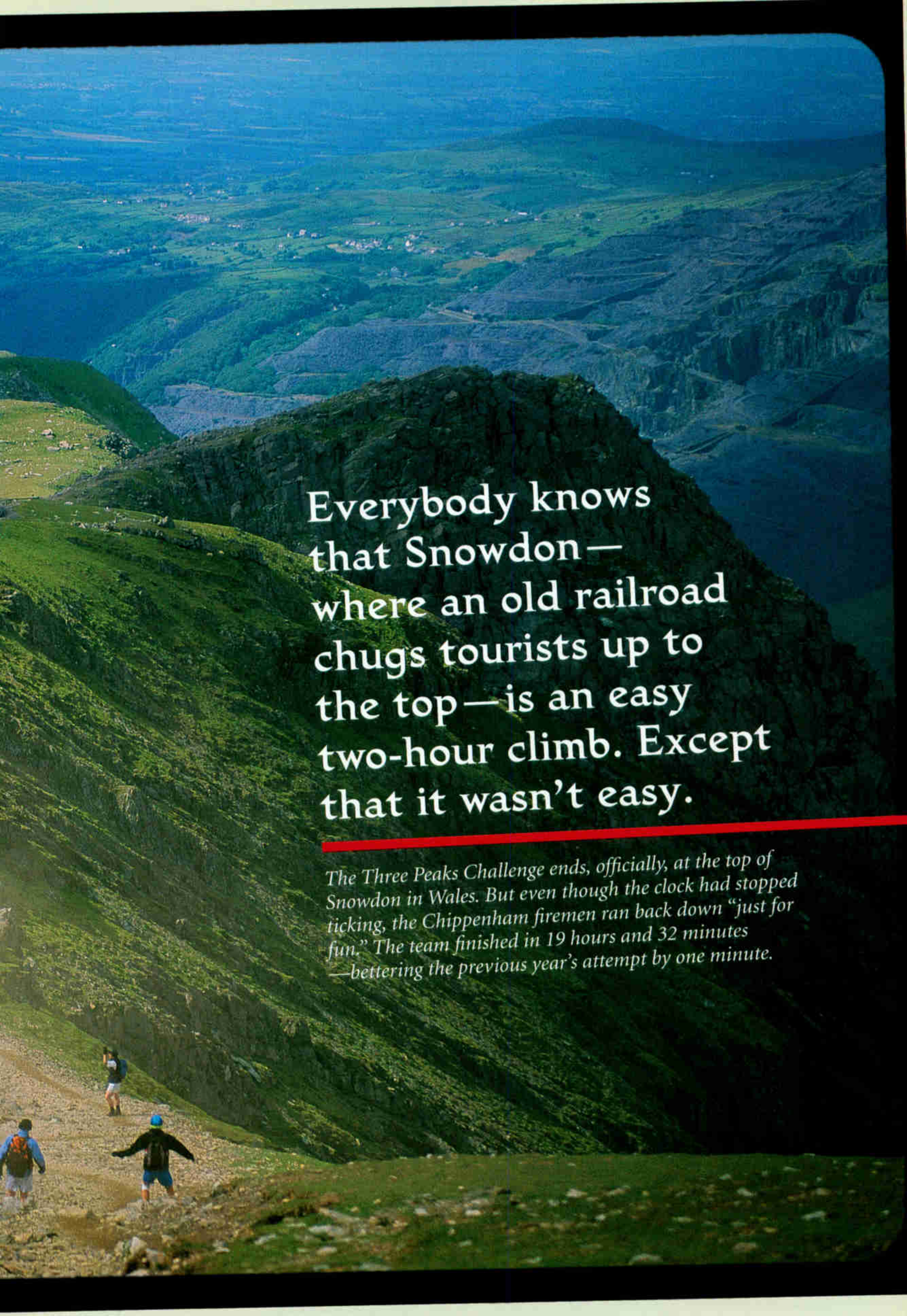
The night before the climb we all gathered in Fort William, Scotland, just below Ben Nevis. We expected a lot of company the next morning. The Three Peaks Challenge has grown so popular that, despite everyone's best intentions, the increased noise, trash, and trail erosion have become a

problem. Mindful of all the factors, Tom told us that his goal was to reach the top of the third mountain in 18 hours, 30 minutes, more than an hour faster than Team Perkins had ever finished before. Kelvin objected. That was too ambitious even for the experienced members of the team, he said, not to mention the rookie climber from America. As all eyes turned to me, I admitted sheepishly that my goal was to finish in 23 hours, 59 minutes, 59 seconds—and I wasn't sure I could make that.

For a moment, I feared a nasty trans-Atlantic contretemps. But that tough Chippenham crew proved to be adept at international diplomacy. Over prodigious quantities of beer, we worked out a mutually satisfactory modus ascendi: The selfless Kelvin volunteered to form a sub-team with me. We would start up Ben Nevis a couple of hours earlier than the others, so as not to hold them back. On the following two mountains, we'd work out a similar accommodation.

PHOTOGRAPHER'S NOTES

I was trying to get some rest on the van's floor. I wasn't succeeding. Perhaps I was thinking about whether I'd ever get another assignment from the GEOGRAPHIC, considering that the high point of coverage so far involved getting a shot of a guy throwing up, and another of two guys peeing by the side of the road.


Everybody knows
that Snowdon—
where an old railroad
chugs tourists up to
the top—is an easy
two-hour climb. Except
that it wasn't easy.
The Three Peaks Challenge ends, officially, at the top of Snowdon in Wales. But even though the clock had stopped ticking, the Chippenham firemen ran back down "just for fun." The team finished in 19 hours and 32 minutes —bettering the previous year's attempt by one minute.

PHOTOGRAPHER'S NOTES

This isn't me, but it could be. Actually, this guy injured himself while running down Scafell Pike. Entire teams run down the first two mountains during the Three Peaks Challenge. They're trying to win gold medals—as our team did—for finishing the race in less than 20 hours. In Nebraska we give out gold medals too. For pie eating.

The next morning, the local TV weatherman forecast a *dreich* day, a guttural Scottish word that connotes dark, wet, windy, and generally miserable. Nonetheless, the base of Ben Nevis was swarming with fire brigade teams (including an all-female squad in running shorts who told me they planned to jog the whole way) when Kelvin and I started climbing late in the afternoon. We crossed the footbridge over a lovely stream with a lovely name, Water of Nevis, and started uphill.

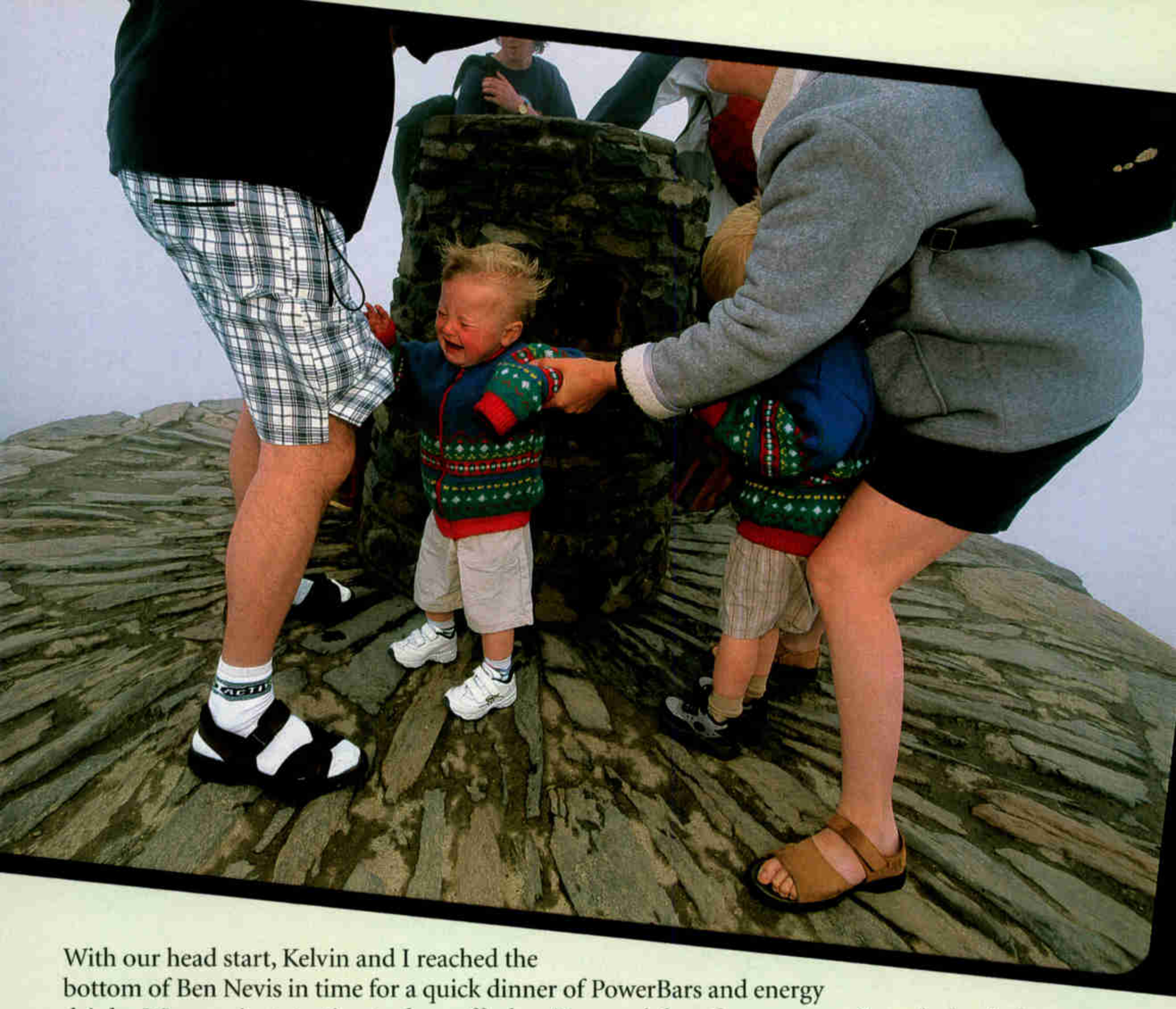
Seriously uphill. Relentlessly uphill. After the first exhausting half hour at Kelvin's swift pace, I swore that I would never again sneer at a measly little 4,408-foot summit.

The path up Ben Nevis winds past a turquoise mountain pond (what the Scots call a *lochan*) and fords a roaring stream that cascades for a thousand feet down the mountainside. In mid-June it's lined with stands of deep purple foxglove and bright yellow gorse, and offers spectacular views of the Highlands, with tiny villages scattered amid dramatic flint outcroppings. Not that a Three Peaker gets to appreciate any of these natural wonders, though—with that 24-hour clock ticking away, you can't stop to look. It felt like riding a race-car through the Louvre, catching a stray glimpse of a masterpiece over your shoulder now and then as you rushed onward.

Roughly two and a half hours from the start, Kelvin and I pulled our way up a long, slippery patch of slushy snow. Suddenly, the steep trail flattened into a granite summit: the rooftop of Great Britain! Partly out of a reporter's sense of duty, but mainly looking for an excuse to rest, I sat down on a rock to record the objects I found there, most of them totems carried up by earlier climbers: a stone from Coventry Cathedral; another from the 1953 Everest expedition; a squat stone pillar labeled "Britain's Highest War Memorial." I was writing busily when Kelvin interrupted me, sounding worried: "It's 21 degrees below zero up here," he said, which would make it about minus 6°F. "The sweat on your clothes is a sheet of ice. I've got to get you down."

As we approached that turquoise lochan on our descent, we ran into the rest of Team Perkins, chugging rapidly upward toward the summit.

Suddenly I was jet-propelled, or maybe joy-propelled, driven by the knowledge that I wouldn't have to climb any more stinking mountains.



Snowdon's windy summit was no peak experience for toddler Adam Crowder (above). Half a million tourists visit the mountain's top each year, many by train.

With our head start, Kelvin and I reached the bottom of Ben Nevis in time for a quick dinner of PowerBars and energy drinks. We were just starting to doze off when Tom and the others came clattering down the trail. Without a second's delay, the climbers scampered straight into the white van and began stripping out of their soaking clothes to put on dry ones as we set off on the six-hour journey south to Scafell Pike.

Some Three Peakers never manage to sleep on the jerky, bumpy ride between mountains; about half our team told me later they were awake, and uncomfortable, all night long. I was far too exhausted to have that problem. One minute I was watching a late, late sunset fall on the unyielding moonscape of the Scottish Highlands, with steep gray cliffs rising abruptly from boulder-strewn valleys. A second later, it seemed, I opened my eyes to a misty dawn over the far more gentle geography of the English Lake District, where fat sheep grazed on lush meadows beneath round green hilltops.

It was 4:50 a.m., and freezing, when the van rumbled past a mountain lake called Wastwater and pulled up at the base of England's tallest mountain. Within just minutes we were on our way up. Scafell is the lowest of the Three Peaks, but by consensus it is the hardest to climb, both physically and psychologically. "The real problem is, it's second," Pete warned me. "You don't have the energy you had at the beginning, but you don't have the second wind that comes from knowing you're on the last one. Anyway, Scafell is a crap mountain. First it's all scree, and straight up.

Then you come to this boulder field. The trail disappears, you get all these false summits, and you want to say, Enough! I'm sick of this."

I told myself that this was just Pete in his whinging mode, but everything he said proved true. The first hour up Scafell Pike, a severe climb along the bed of a cold mountain stream called Brown Tongue, was so tough that Kelvin had to quit the climb because of a sore neck. And then Pete dropped out, too. "I'm totally knackered," he gasped, and the utter exhaustion on his ashen face told me exactly what that British word must mean.

With my closest partners gone, I fell farther and farther behind the rest of Team Perkins. On my own, dazed with fatigue, I was wandering like a lost sheep amid giant rocks halfway up the slope. Then another team, this one from Cambridgeshire, came up from behind and adopted the lost sheep on the spot. "You can make this mountain!" said Matt Day, a cheery, energetic climber with a team of engineers. With the Cambridgeshire team to shepherd me along, I reached Scafell's stern summit and scrambled back down in just over four hours, only 52 minutes behind my Perkins teammates.

PHOTOGRAPHER'S NOTES

We celebrated our Three Peaks victory at a pub. Obviously I'd had a few too many mountains that day. Let's face it, people like me aren't meant to climb mountains, and certainly not three in one day. There should be signs saying, "No butterballs with cameras beyond this point." I'd never changed film while running before, and I don't want to do it again.

As we agreed in advance, Team Perkins went ahead toward Snowdon without waiting for me. I hitched a ride in another van for the pretty drive down the west coast of England to the slate black mountains of north Wales. Exactly five hours after leaving Scafell, I saw the dark pyramid of Snowdon towering above a trio of crystalline alpine lakes (what the Welsh call *llynnoedd*). Starting up the trail, I felt tired but elated. It was 2 p.m. and I had more than three hours left before the 24-hour limit ran out. And everybody knows that Snowdon—where an old railroad chugs tourists up to the top—is an easy two-hour climb.

Except that it wasn't easy. With every uphill step, my muddy, bloody, depleted body told me that three peaks in 24 hours was just too much. As I hiked along the bank of the highest llyn, I desperately wanted to plop my bum beside the cool waters and sit there forever. Then, with a steep half mile still to go, the trail made a sharp turn to the south—directly into a 40-mile-an-hour head wind that did its best to blow me all the way back downhill.

And yet I fairly flew up that last half mile. For now I could see, straight ahead, the top of Snowdon and the end of the 24-hour ordeal.

Suddenly I was jet-propelled, or maybe joy-propelled, driven by the knowledge that I wouldn't have to climb any more stinking mountains. I cruised happily to the summit with a smile on my face that did not fade.

I was still wearing that stupid grin hours later when Team Perkins gathered at a pub for a session listed on our schedule as "major rehydration." Not everybody was as cheerful as I. Our captain and three other team members had completed the Three Peaks in 19 hours, 32 minutes—a fantastic achievement for most people, but less than satisfactory for "a pretty determined person" like Tom Perkins. "It was good, but not what I was looking for," Tom told me, with a pint of ale in his left hand and a sheaf of papers under the stump of his right arm. "At least this gives us a goal to shoot for next year."

The team's American contingent, of course, had no plans whatsoever to climb again next year. Joel had his photos, and I had an official time of 22 hours, 55 minutes in the recorded annals of the Three Peaks Challenge. That ranked me perilously near the bottom of the 800 fire brigade climbers who completed the ordeal in 2002. But no matter. I had come in under 24 hours. I felt as if I had won the lottery.

And maybe I had. As a member of a fire brigade team, I had to buy raffle tickets worth 30 British pounds—about 47 dollars—with proceeds benefiting the Fire Services National Benevolent Fund. I may even have the winning ticket—but I absolutely refuse to find out. That's because the grand prize in the lottery was ten days of climbing the peaks of the Andes in Peru. After my own one-day climb of Britain's Three Peaks, that's a prize I hope I never, ever win. □

The Challenge was finished—and so were the firemen, slumped in sleep as the van headed home. Their resolve to help Tom Perkins, right, recover from a near-fatal accident got them started as Three Peakers. Four years and four races later, friendship keeps them going.

WEBSITE EXCLUSIVE

Share the best, worst, and quirkiest moments from the author and photographer in On Assignment, and find more photos at **nationalgeographic.com/ngm/0307**.

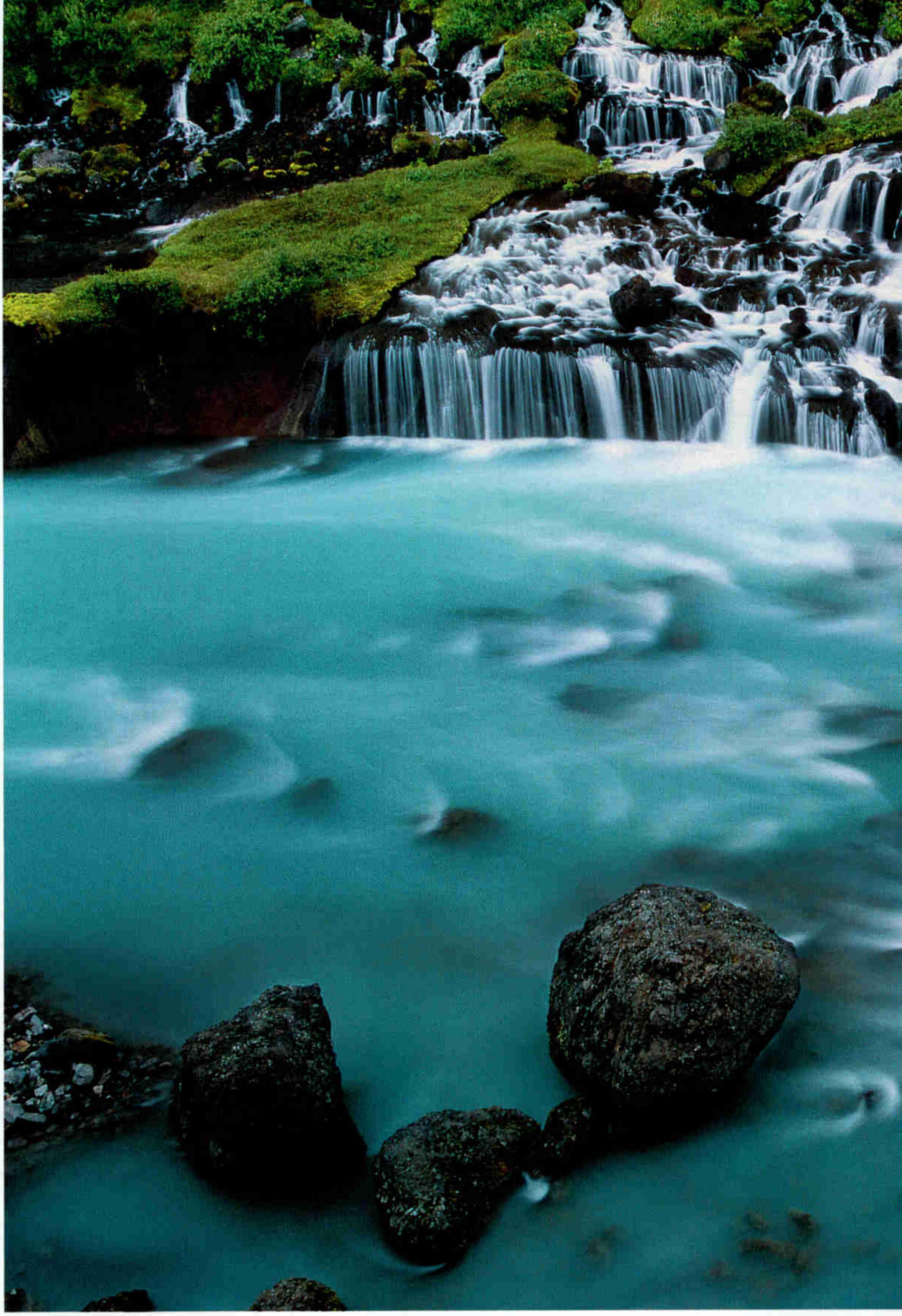
Everybody Loves

Atlantic Salmon

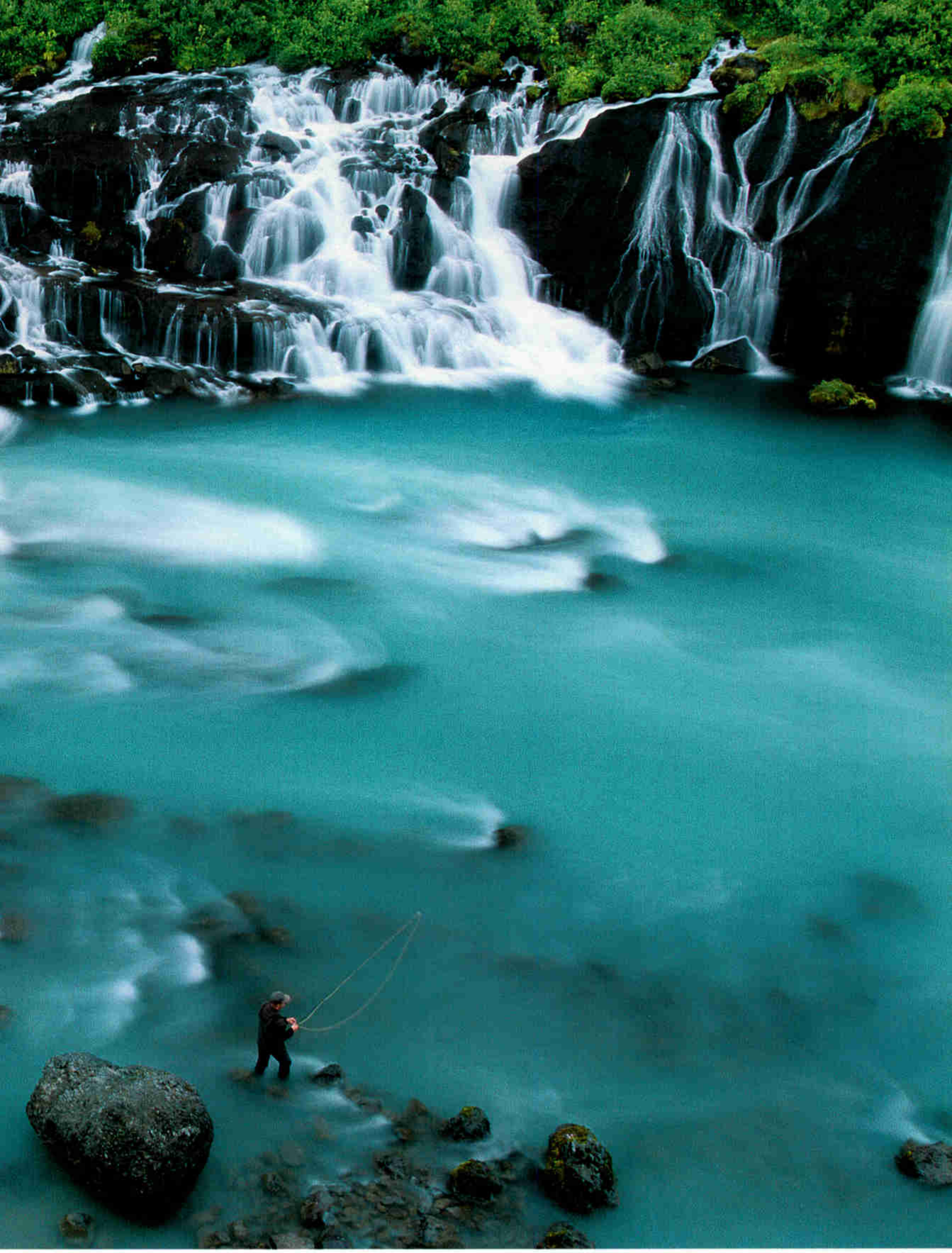
Here's the Catch...

Surviving nets, habitat loss, and a flood of farmed fish, Atlantic salmon face an uncertain future.

As wild populations falter and salmon farms go global, this noble sport fish has turned into the chicken of the sea.



SUNKEN TREASURE



"His fishing was not a sport . . . but a . . . solemn sacrament," wrote Henry David Thoreau of an angler on Massachusetts's Concord River, which lost its salmon to dams in the 1800s. Fishermen now travel far to stalk healthy streams such as Iceland's Hvítá River (above).

BY FEN MONTAIGNE
PHOTOGRAPHS BY PAUL NICKLEN

Standing on a grassy bank of the River Deveron, Lord Marnoch, an eminent Scottish judge, is attached—via a 12-foot fly rod, a bit of line, and a hook—to an Atlantic salmon. The creature struggling to dislodge Lord Marnoch's fly from its jaw was spawned in the Deveron, resided several years in the river, and has spent the past year fattening up in the North Atlantic, probably near the Faroe Islands or Iceland, before completing its long migration home to reproduce. It is a strong, wild, young salmon of about five pounds, known as a grilse, and it was doing fine until it entered the Deveron and succumbed to the allure of Lord Marnoch's delicate, orange fly.

Lord Marnoch is the very picture of the classic Atlantic salmon angler. A distinguished-looking man of 62 with a thick head of graying hair, he is dressed on this cool July day in moss green knickers, a beige cashmere sweater, and a brown tie. Over his knickers he is wearing pale green waders. He carries a wooden walking stick and wears a tweed, olive-colored deerstalker cap. He was born Michael Bruce, but upon being elevated to Scotland's High Court he was given the title of Lord Marnoch, an honor he wears with ease. He and several friends have come to the Deveron in northeastern Scotland to catch the king of game fish, a highly civilized pursuit that involves much angling but also pleasant hours eating pâté sandwiches and drinking single-malt whisky in a green hut by the Deveron. It is a picturesque river, about 25 yards wide in this stretch, and flows placidly through a hilly landscape that is a checkerboard of green wheat fields, slopes of golden barley, and tidy forests of larch, beech, and alder.

The fish is holding firm in the depths of a tea-colored pool, its resistance causing Lord Marnoch's rod to bend and his line to shudder. Shadowing the judge is his gillie, or fishing guide, Harvey Grant, a man who comes to the river dressed in a windowpane tweed suit and who, in his Scottish brogue, gently dispenses words of advice: "Walk it upstream, sir, just like you're walking a dog."

Soon, Lord Marnoch has reeled the silver creature into the bank, where Grant nets it.

"Not a bad wee grilse," says Lord Marnoch.

"Kill it, sir?" asks Grant.

"Absolutely," replies Lord Marnoch, whereupon the gillie grabs a rock and ends the salmon's migration with a firm tap to the head.

"I really think these beautiful creatures are far too fine to be played with and put back," says Lord Marnoch, a salmon conservationist who nonetheless believes in killing a few for the pot. "Catch-and-release fishing is rather like in the Roman arena going thumbs up or down. If a beautiful creature has succumbed to me, I think the right thing is to hit it on the head."

The scene is a timeless one, and the grilse caught by Lord Marnoch fits the image of an Atlantic salmon: *Salmo salar*, the "leaper" in Latin, a sleek, chrome-colored fish that fights its way up northern rivers, jumping rapids and waterfalls on its spawning run. The truth is, however, that wild Atlantic salmon have been in steep decline for decades, and today the North Atlantic is dominated by a new kind of salmon. It can be found not far from Lord Marnoch's fishing hole on the Deveron, packed into sea cages in the lochs of western Scotland. There, about 50 million farmed Atlantic salmon swim round and round in pens as they are fed pellets to speed their growth, pigments to mimic the pink hue of wild salmon flesh, and pesticides to kill the lice that go hand-in-hand with an industrial feedlot. It is these salmon that you purchase at the market for five dollars a pound, and today in Scotland—as in many North Atlantic countries—farmed salmon outnumber wild salmon by 300 or 400 to one. Indeed, in Norway, whose long coastline harbors the world's largest population of wild Atlantic salmon, a single fish farm

"The Atlantic salmon is a power-packed, leaping, silver thing of beauty."

LABOR OF LOVE

"When these fish take your fly, your heart misses three beats," says Cascapédia River manager Marc Gauthier. Here he releases a huge male used in a spawning-enhancement program. Even on Canada's best streams, less than 8 percent of smolts survive to spawn.

produces as many salmon a year as the estimated 600,000 wild salmon that migrate up the country's 650 salmon rivers to spawn.

Now there is growing evidence that pen-raised Atlantic salmon are threatening their wild brethren. If so, aquaculture would be the latest in a long line of insults that have whittled down the once great numbers of wild salmon, whose presence has lent magic to rivers on both sides of the North Atlantic.

No one knows for sure, but scientists estimate that before the industrial age at least ten million salmon returned annually from the sea to an arc of rivers that ran from the Hudson in New York, up through New England and eastern Canada, across to Iceland and the British Isles, over to Scandinavia and the Baltic, up to northern Russia, and down the Atlantic coast of Europe to Portugal. Salmon once migrated in immense numbers up such renowned rivers as the Connecticut, Thames, Rhine, and Loire.

Then came the industrial revolution, and with it the dams and pollution that, by the mid-20th century, had rendered rivers like the Thames and Rhine uninhabitable to salmon. From the mid-1960s to the early 1980s an equally strong blow came as the international fishing fleet discovered a major salmon feeding ground off Greenland, setting off a netting frenzy that led to several million wild salmon being killed annually in the North Atlantic. Governments and conservation groups, working with the North Atlantic Salmon Conservation Organization, struck back by launching an ongoing effort to buy out and regulate salmon fishermen, a successful campaign that has drastically reduced commercial salmon fishing in the Atlantic.

By the late 1990s, with most commercial nets retired, conservationists were eagerly awaiting a rebound in salmon numbers. So far they've been disappointed. Wild Atlantic salmon populations now hover around 3.5 million—half what they were 30 years ago and a fraction of the estimated 500 million wild Pacific salmon.

FEEDLOTS OF THE SEA

Atlantic salmon farms are flourishing in the Pacific, with Chile and British Columbia now major producers. Farms like this one off Vancouver Island bring jobs but also pollution, diseases, and escaped fish that threaten to displace native salmon.

The World Wildlife Fund recently reported that Atlantic salmon are endangered or threatened in close to 60 percent of their range. In the United States—whose rivers were once home to a population of roughly half a million Atlantic salmon—the number of wild *Salmo salar* has collapsed to a few hundred. The list of suspects in the continuing decline is long, including degradation of rivers, acid rain, shrinking ocean habitat (possibly related to global warming), netting of juvenile salmon by herring and mackerel trawlers, and aquaculture.

"It's death by a thousand cuts," says Frederick G. Whoriskey, Jr., vice president for research at the Atlantic Salmon Federation, a leading salmon conservation organization.

The cut that most concerns many conservationists today is fish farming. From its cottage-industry beginnings in Norway in the late 1960s, Atlantic salmon farming has exploded into a two-billion-dollar-a-year business that produces 2.6 billion pounds of fish.

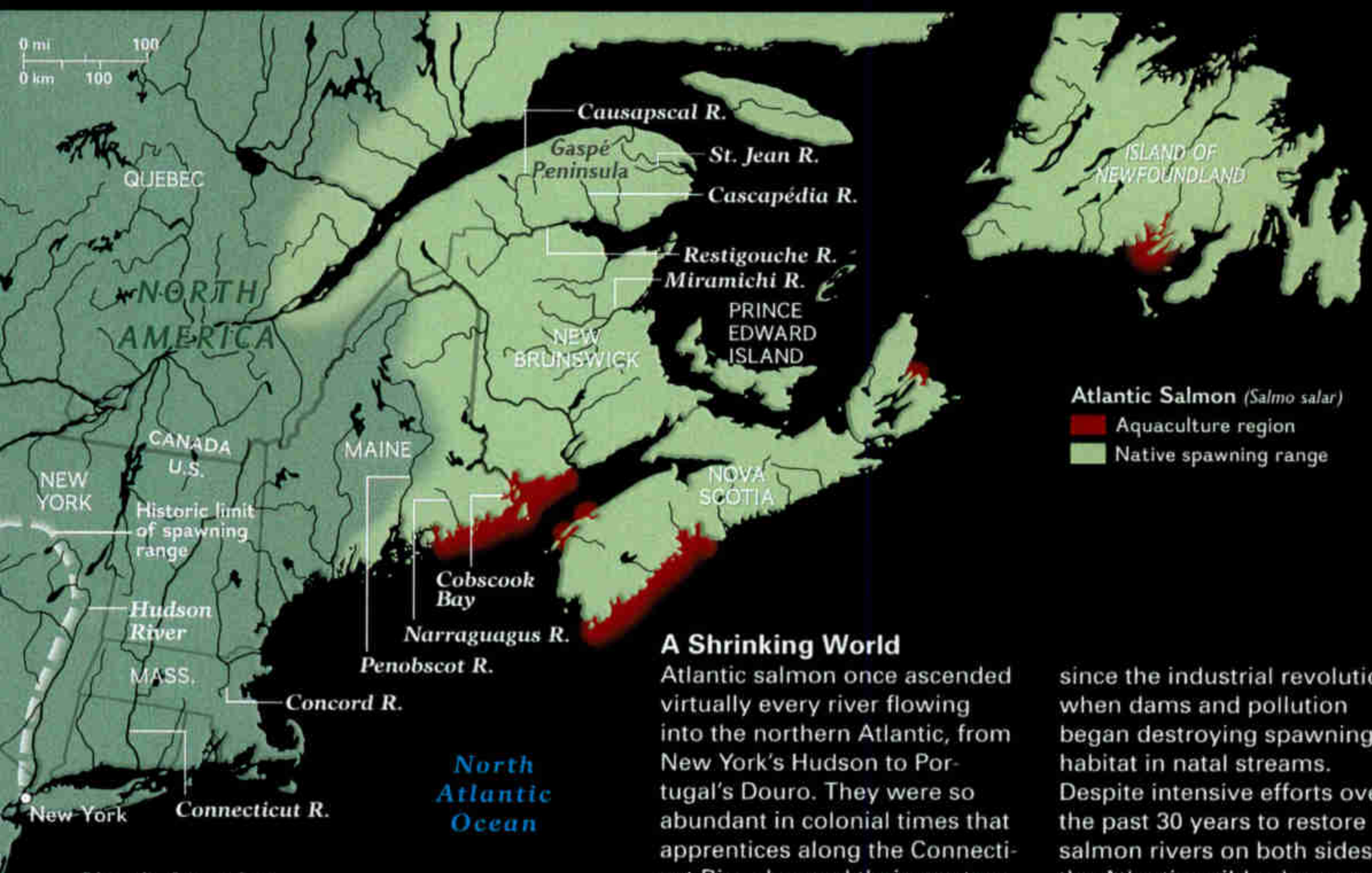
Now largely controlled by a handful of multinational corporations, the Atlantic salmon aquaculture industry has even spread to the Pacific, with Chile rivaling Norway as the world's leading producer of farmed salmon. The industry has brought what was once an expensive seasonal delicacy into the reach of the common man. Today farmed salmon is truly the chicken of the sea.

Salmon aquaculture has created undeniable benefits, which include taking commercial fishing pressure off wild salmon stocks and providing employment to depressed maritime areas. But the mass production of this magnificent migratory creature has come at a cost. Hundreds of millions of salmon in cages have fouled the sea around their pens, spread diseases and sea lice to wild salmon, and led to large numbers of escaped fish. Runaway domesticated salmon have begun interbreeding with wild salmon, a development that could lead to a new hybrid that is far less capable of making the heroic spawning and feeding journeys that are the hallmark of the Atlantic salmon.

"Aquaculture is the single most serious threat to the survival of Atlantic salmon," says Donal C. O'Brien, Jr., chairman of the Atlantic Salmon Federation. "Unless *(Continued on page 112)*

DISTRIBUTION

Of the world's roughly 300 million adult Atlantic salmon, only 3.5 million are wild.



North America

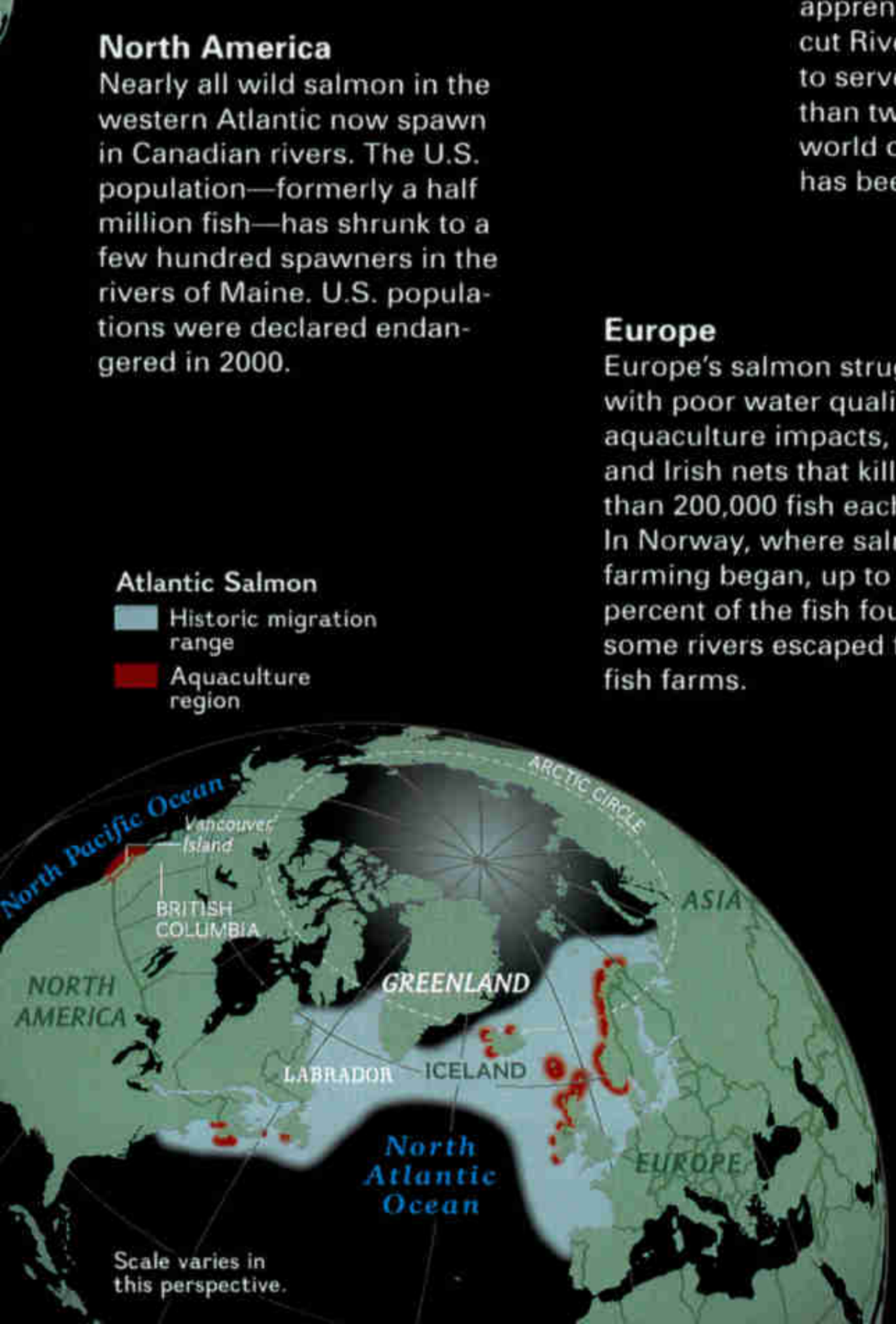
Nearly all wild salmon in the western Atlantic now spawn in Canadian rivers. The U.S. population—formerly a half million fish—has shrunk to a few hundred spawners in the rivers of Maine. U.S. populations were declared endangered in 2000.

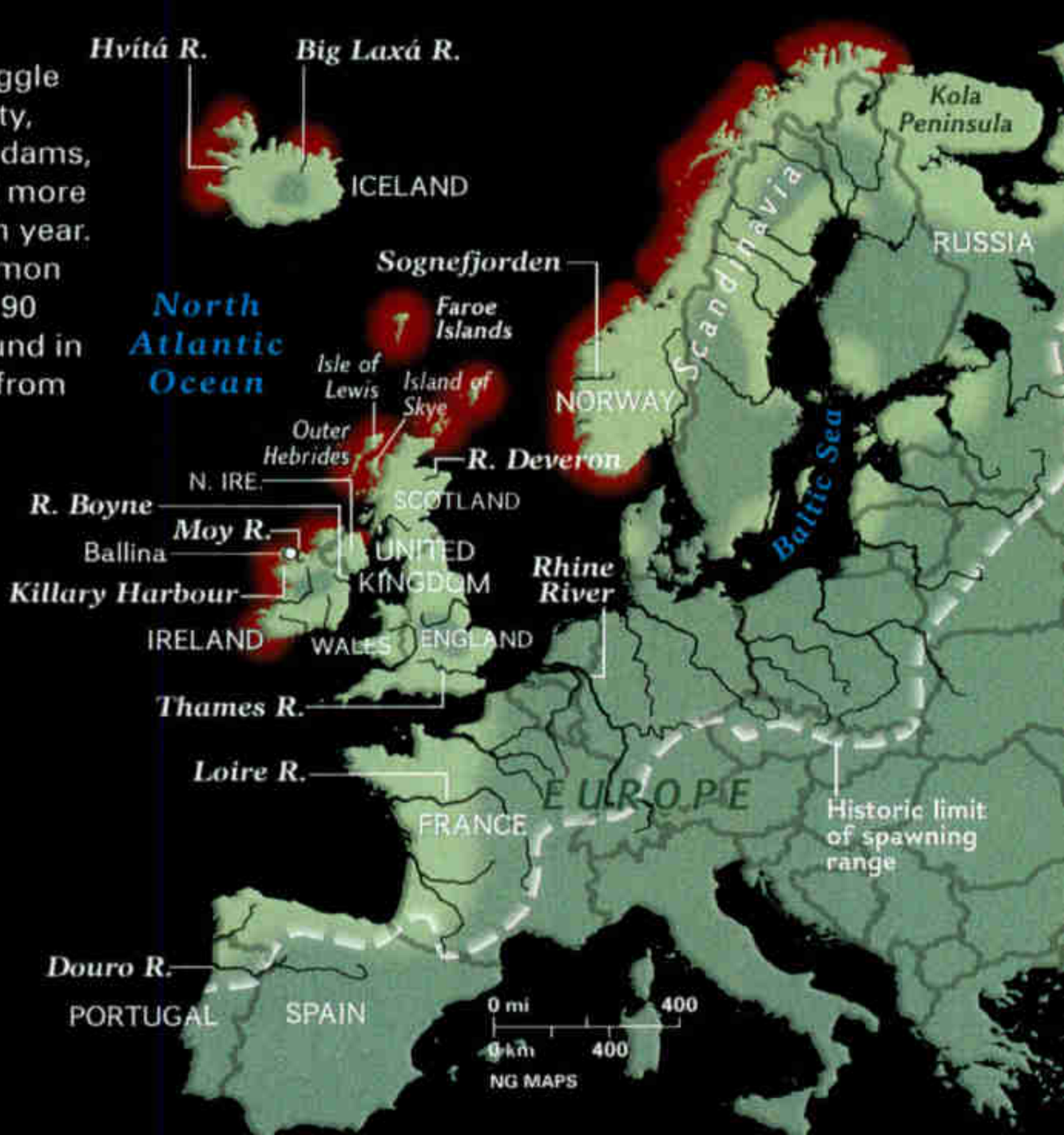
A Shrinking World

Atlantic salmon once ascended virtually every river flowing into the northern Atlantic, from New York's Hudson to Portugal's Douro. They were so abundant in colonial times that apprentices along the Connecticut River begged their masters to serve them salmon no more than twice a week. But the world of the Atlantic salmon has been shrinking steadily since the industrial revolution, when dams and pollution began destroying spawning habitat in natal streams. Despite intensive efforts over the past 30 years to restore salmon rivers on both sides of the Atlantic, wild salmon numbers continue to fall. At the same time, salmon farming has blossomed into a two-billion-dollar-a-year business.

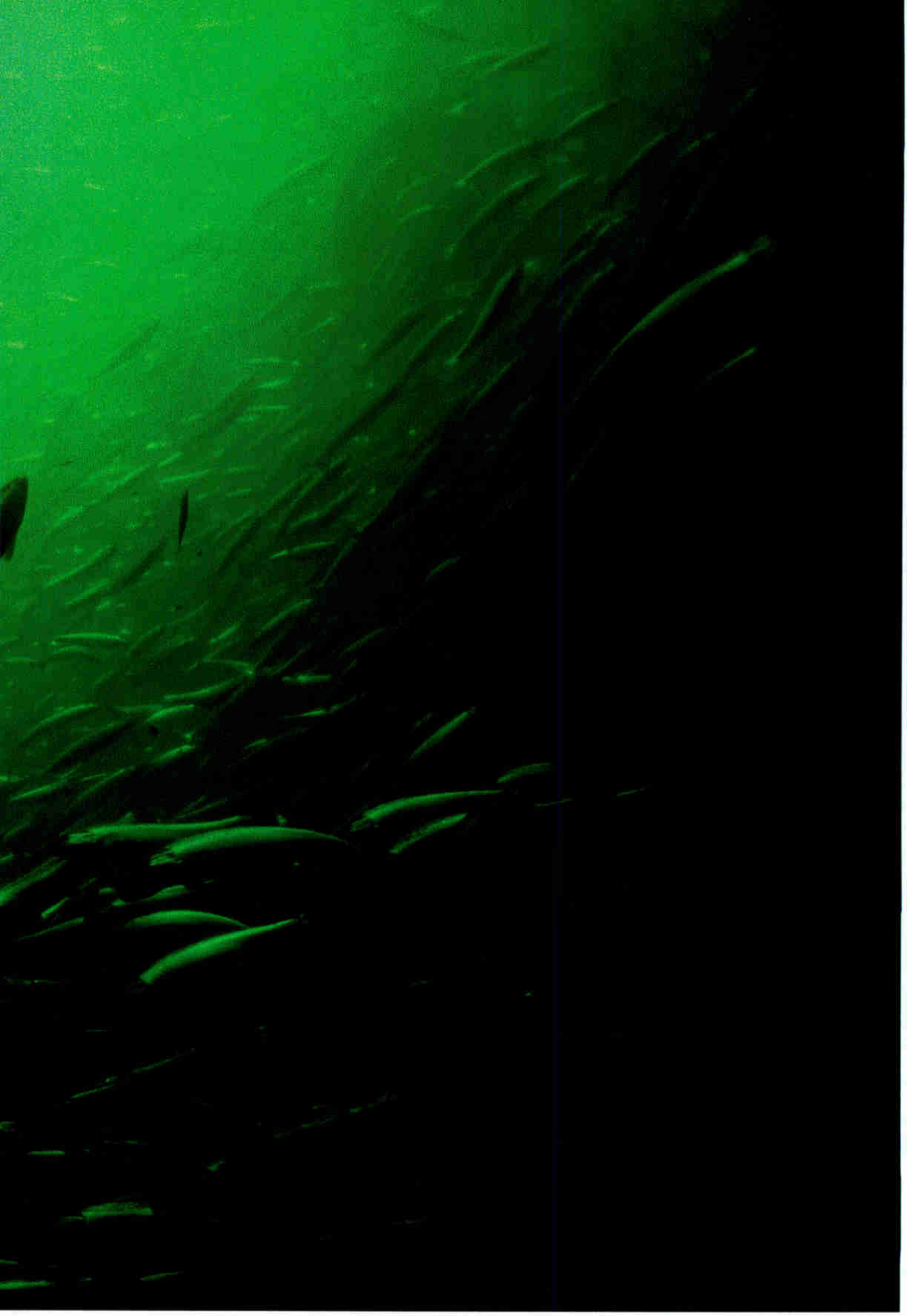
Europe

Europe's salmon struggle with poor water quality, aquaculture impacts, dams, and Irish nets that kill more than 200,000 fish each year. In Norway, where salmon farming began, up to 90 percent of the fish found in some rivers escaped from fish farms.





LIFE IN THE PEN



A diver descends into a vortex of 50,000 farmed salmon in a British Columbia sea pen to inspect its net. Roughly two years old, these fish are twice the size of wild salmon of the same age—but half as wary. Sea lions often chomp them through the nets.

FISH FARMING

A GROWTH INDUSTRY

Norway first developed Atlantic salmon farms in the late 1960s. The industry, still dominated by Norwegian firms, quickly spread to the U.K. and Canada in the 1970s, the United States in the 1980s, and Chile in the 1990s. Today uniform slabs of farmed Atlantic salmon, available year-round, have virtually replaced wild Atlantic salmon on fish counters in North America and Europe. Dwindling runs, rock-bottom prices, and international efforts to buy out and regulate commercial salmon fishermen reduced the reported catch of wild fish to less than 3,000 metric tons in 2000. Only England and Ireland still allow significant commercial catches, and efforts are under way to retire those nets as well. Meanwhile, salmon farms continue to expand.

ROAR A. LUND

PANACEA OR PANDORA'S BOX?

Conservationists initially heralded salmon farms as a way to relieve fishing pressure on wild populations—until the farms began threatening wild fish. The tightly packed pens prove an ideal breeding ground for sea lice (above, trailing egg strings), naturally occurring parasites that have devastated some salmon and sea trout populations in Europe. Wild smolts can pick up lice as they swim past infested pens. Fish farms have also spread deadly diseases to wild salmon through escaped fish. Such problems have declined as farming techniques have improved, but escaped fish (some half a million a year in Norway alone) remain a serious threat. They compete and breed with wild salmon. The resulting hybrids may lack the skills necessary to survive.

FEEDING FRENZY

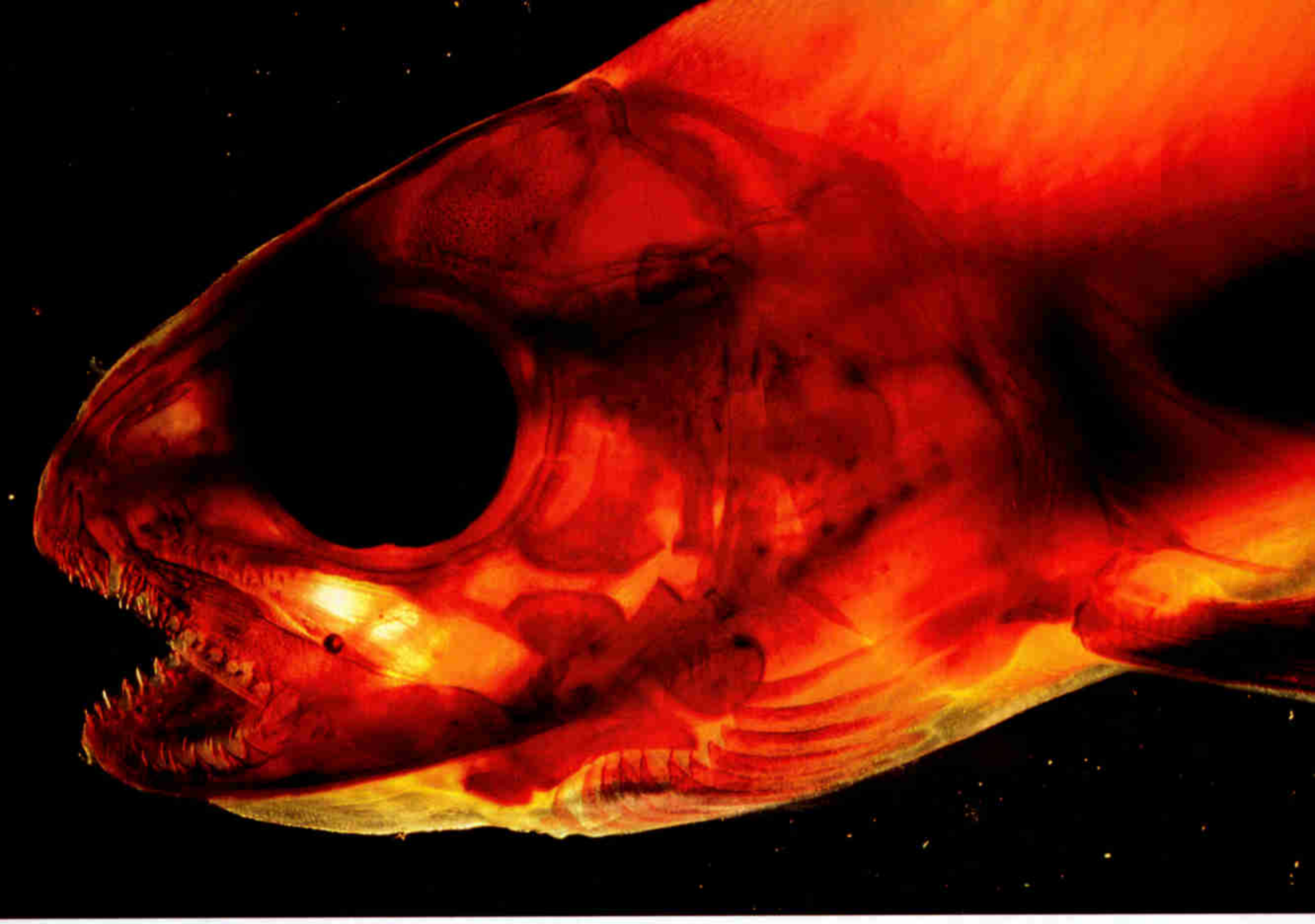
Packed with healthful omega-3 fatty acids, salmon is the darling of diet gurus. Yet critics say it takes four pounds of fish rendered into food pellets to produce a pound of farmed salmon. Industry experts counter that it takes less feed to produce a pound of salmon than a pound of poultry or pork. Pesticides and antibiotics are fed to the fish as needed.

GRAPHICS BY TIMOTHY ALT; ART BY JOHN DAWSON.
SOURCE: HISTORICAL CATCH RECORD FOR 1960-2000, NORTH ATLANTIC SALMON CONSERVATION ORGANIZATION

A farm with a million salmon uses
up to 55,000 pounds of fish food a day.

FOOD COLORING

It takes about 18 months for three-ounce smolts (above, being piped into a sea pen) to reach 12 pounds. That's a good size for Greg Buttle (right), chief smoker at Quebec's Ristigouche Salmon Club, who now prepares farmed fish instead of wild. Natural pigments in shrimp and other prey of wild salmon create its trademark pink hue. Coloring agents added to feed pellets enable growers to do the same.



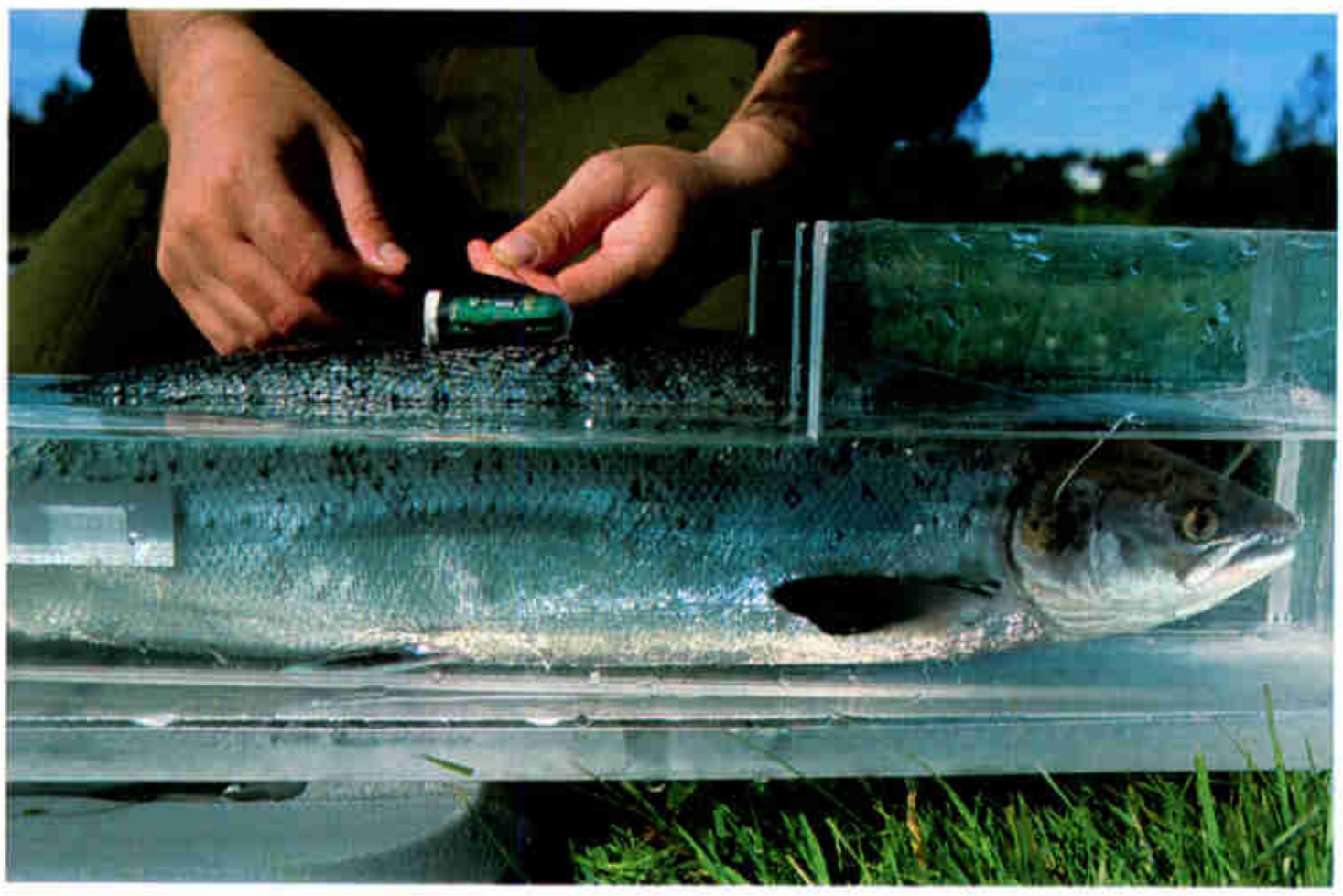
(Continued from page 106) it is brought under control, it will one day bring about the extinction of the species."

O'Brien's prognosis is debatable, but what is inarguable is the striking contrast between a wild Atlantic salmon and a farmed one. Instead of roaming freely across the Atlantic as they complete the mysterious, obsessive quest to get back to their home rivers, caged salmon swim ceaselessly in circles, their fins worn from rubbing into other fish and nylon nets. The only outlet for their strength is to skitter on their tails in short bursts across densely packed pens.

"You have 800,000 of these creatures crammed into cages in one spot, fed chemicals, and defecating in a shallow estuary," says Patrick O'Flaherty, general manager of Ballynahinch Castle, a famed fishing hotel in Connemara, Ireland, that saw its wild salmon and sea trout stocks collapse as sea lice infestations spread from nearby fish farms. "Do we need this? Is it sustainable? When you take one of the most noble creatures on the planet, a creature that makes these epic voyages, and bend it to the will of man, it is a recipe for disaster. It goes against everything that is natural."

If your desire is to see Atlantic salmon in something close to their primordial state, there are few better places than Iceland, the strikingly beautiful accretion of volcanic rock, glaciers, and fertile pastureland in the heart of the salmon's range. Anglers who ardently pursue Atlantic salmon, often paying $1,000 to $2,000 a day for the privilege, say they are drawn as much by the splendid neighborhoods the salmon inhabit as they are by catching these large, powerful fish. Iceland is typical Atlantic salmon country: remote, unspoiled, blessed with clear, cold rivers, and painted during the summer fishing season with the two-hour sunsets of the northern latitudes.

Orri Vigfússon has probably done more than any other individual to reduce the commercial netting that was decimating wild Atlantic salmon. His dedication to the fish arose out of his passion for catching them in his country's rivers. One of his favorites is the Big Laxá in the north, 40 miles below the Arctic Circle. Like most of Iceland's hundred salmon rivers, the Big Laxá still has a healthy salmon population because it has almost no dams, no industry, no aquaculture, and few people living along its banks.



SALMON UNDER GLASS

Myriad causes have contributed to the Atlantic salmon's decline, including moth repellent dumped in Scottish rivers in the 1970s by tweed manufacturers. The chemical caused spinal deformities in juveniles, like the one prepared for study (left). Such smoking guns are harder to find these days. Iceland's spawning rivers remain virtually unchanged since the last ice age, yet large numbers of its two-year-old fish are dying at sea. Scientists hope sophisticated data-storage tags (above) that record depth, salinity, and water temperature will provide answers.

One evening in early July, Vigfússon walks across small grass-covered hummocks of lava to the Big Laxá, which is a hundred yards wide and flowing gently toward a wide bay flanked by gray basalt mountains streaked with snow. The temperature is 40°F, and as Vigfússon begins casting his two-handed rod, the sun breaks through scattered clouds and floods the landscape with a golden light. A salmon swirls behind Vigfússon's fly but fails to strike it on a half dozen subsequent casts. It doesn't matter. Vigfússon, the 60-year-old chairman of the North Atlantic Salmon Fund, has caught countless salmon in his lifetime, and he is here to participate in a national ritual. In this small country, Atlantic salmon—which, unlike Pacific salmon, can survive after spawning—are as much a part of the national identity as volcanoes.

"For us it is an art form; it is not sport," says Vigfússon, a short, pug-nosed man with sandy hair and gray-blue eyes. "Maybe it is a kind of patriotism to protect this place."

Iceland's salmon rivers are among the best managed in the world. Every river is overseen by an association of owners, many of them farmers, who lease fishing rights to clubs, anglers, and outfitters. The average farmer makes about $10,000 a year from fishing leases, with some earning as much as $70,000. Overall, salmon sportfishing annually pumps 20 million dollars into Iceland's economy.

It was a recognition of the salmon's importance to Iceland that led Vigfússon to launch his net buyout campaign in the late 1980s, when salmon were in an alarming free fall throughout the Atlantic. The Canadian government, pressured by the Atlantic Salmon Federation, had already begun the largest buyout of salmon fishermen—a 72-million-dollar (Canadian) effort that retired 7,000 netsmen in the Maritime Provinces. Vigfússon concentrated successfully on retiring nets in the Faroe Islands, Iceland, Greenland, and Wales. To date he has raised 20 million dollars, including much of his

Salmon sportfishing pumps 20 million dollars into Iceland annually.

own money, to pay fishermen to put down their salmon nets and take up other forms of fishing or change careers.

Now Vigfússon, the son of a commercial fisherman, has set his sights on the remaining salmon netsmen in the Republic of Ireland, northeastern England, and Norway. One of the groups he'd like to put out of business is the Flaherty clan.

Killary Harbour is a 12-mile finger of water that extends from the Atlantic Ocean into the verdant hills of Connemara in western Ireland. Driving along the harbor on a cool, overcast afternoon, dodging sheep on the narrow, winding road, I spy a hand-lettered sign that advertises, "Get your wild salmon here." I follow a path through a meadow, then come upon the fishing operation of Thomas Flaherty, the 80-year-old patriarch of a family that makes its living netting Atlantic salmon in the harbor and just offshore. Flaherty, a slender, gray-haired man in yellow oilcloth overalls and a plaid porkpie hat, is sitting on a bluff in a plastic chair, puffing on a cigarette as he scans the gray waters of Killary Harbour. Near an enclosure carved into the bluff are his son John Joseph, 41, his red-haired grandson, Jason, 13, and two other men. They are practitioners of an old art known as draft netting, which involves spotting migrating salmon from a perch above the harbor, then rowing out in a wooden boat to encircle the fish with a net.

Thomas Flaherty and his crew are hospitable and garrulous, serving tea heated in a twig-fired contraption known as a Kelly kettle. Soon I join the men at their lookout, unable to detect the subtle movements across the surface of the harbor that alert them to migrating salmon. Nor can I fathom the meaning of the thickly accented exclamations that pinpoint the location of the fish. "There he is! Is he over? . . . He's high. . . . Now, go for him!" The younger men scramble down steps cut into the bluff and row hard as the senior Flaherty follows behind and prepares to haul in the net. I spend many hours with the Flahertys over two days, but I bring bad luck; in my presence they land only one salmon. On the second day, as a cold Irish rain blows sideways into their hut, Flaherty laments the poor fishing: "Great Gawd Almighty in the night! We've been after too many dodgy ones now. Ah, they're comin' very foul today."

In a typical, 40-day season, the Flahertys usually catch about 1,200 salmon. Another of Flaherty's five children, 50-year-old Tommy, nets salmon offshore. This is a considerably more productive fishery, accounting for most of the 210,000 Atlantic salmon caught by Irish commercial fishermen in 2002. Vigfússon figures it will cost at least 50 million dollars to persuade the Irish netsmen to stop, and he plans to raise a third of that himself and wheedle the remainder out of the Irish government. Many Irish fishermen, battered by steadily shrinking fishing seasons and prices driven low by aquaculture, say they are ready to bargain with Vigfússon.

Flaherty, for one, is aware that the netsman's way of life is as threatened as the salmon.

"They're squeezing us out," he says as he sizes up the picturesque sweep of Killary Harbour. "If the buyout was good, I would consider it. But I dread to think there'd be a day when no one can come out and do what we've done for hundreds of years. I would hate to see this fishery close down. It would really make me weep."

But even if the Flahertys and their cohorts lay down their nets, there is no guarantee that wild Atlantic salmon will recover. After nearly three decades of steadily declining commercial harvests, the fish have not made a major comeback. Scientists are mystified, although they know that part of the problem is the loss of large numbers of young salmon at sea. But conservationists are focused on a highly visible suspect—aquaculture.

"Every place where there is a high concentration of aquaculture, the wild salmon stocks are going down the tubes," says Bill Taylor, president of the Atlantic Salmon Federation, which initially supported salmon farming because it would ease commercial fishing pressure.

Sitting on the far edge of the Isle of Lewis in

CALL OF THE WILD

Hook-jawed and aggressive, a male salmon in Quebec's St. Jean River fertilizes the eggs of a hidden mate. Rivals of all sizes swarm in soon afterward to do the same, ensuring a deep gene pool. Unlike Pacific species, Atlantic salmon can survive to spawn again.

Scotland's Outer Hebrides is one of the aquaculture operations that have reduced the salmon's complex life cycle to fish pellets and computerized feeding schedules. On a misty morning I board a boat for a trip to one of Scotland's 350 salmon farms—a cluster of a dozen cages, each 20 yards square, where the world's third largest salmon-farming company, Fjord Seafood, is growing its product. My guide is Brian Shaw, who is in charge of running five Fjord Seafood sites, each of which produces about 700,000 salmon every other year. Salmon aquaculture now accounts for 40 percent of Scotland's food exports, more than Highland lamb and beef combined.

As we near the cluster of cages, I hear the background music of salmon farming—the rattle of the small brown food pellets being shot through pneumatic pipes and hitting the water like a hard rain. The pewter-colored salmon roil the water as they chase breakfast. On a barge that holds four silos of food, worker Iain Jonah Macleod steps inside a shed, glances at a computer, and informs me that the fish in cage A-8 are nearly finished their morning feeding and have devoured 531 of the 976 pounds of pellets they will be allotted that day. The highly efficient farming system can take strains of Atlantic salmon, specially selected for rapid growth, and raise them from fertilized eggs to nine-pound salmon in about two and a half years—twice as fast as in the wild.

"We're producing food here, and it's a high-density operation," says Brian Shaw as we stand on a metal walkway between the salmon pens. "All we do is imitate what's in nature. These fish grow quite well here. They seem quite happy."

About 60 people work in Shaw's fish farms, part of the 1,400 workers directly employed in salmon aquaculture in Scotland. (Another 5,000 work in related industries, according to Scottish Quality Salmon, a trade industry group.) That employment is undeniably important to economically hard-hit areas like the Outer Hebrides. But the advent of mechanized feeding and other efficiencies has meant that aquaculture provides fewer jobs than promised. Indeed, in Scotland, as the production of salmon increased fivefold between 1990 and 2002, the number of workers employed on fish farms actually decreased. At the same time, large corporations have acquired many small salmon farms, reflecting a worldwide trend that has left nearly half of all

It's not easy becoming an Atlantic salmon. Only 30 percent of the eggs (top) laid each fall hatch into alevins (right) in early spring. When the food stored in their yolk sacs is gone—after about six weeks—the young fry hunt for food, mostly insects. Within days they acquire the vertical bars of the parr stage for camouflage, yet only a third survive the year. In the parr's second or third spring (below), they become smolts and head to sea. Some return as two- to six-pound grilse (bottom) after only a year in the ocean. Others stay up to five years, doubling in size annually. One egg in 4,000 manages to complete the cycle.

SALMON LIFE CYCLE

A large female salmon will lay up to
20,000 eggs in one spawning season.

DEEP TRADITIONS

Irishmen have been chasing salmon since mythic hero Finn MacCool ate the Salmon of Knowledge from the River Boyne and gained eternal wisdom. Salmon fever afflicts Irish anglers from all walks of life, from Ballina townsmen (above) who pay $40 a year to fish the Moy River, to jet-setting consultant Sam Hay (right, at center), who each year pays $3,000 for a week's fishing at Amhuinnsuidhe Castle, a retreat in Scotland's Outer Hebrides. "These fish are the epitome of the wilderness and the sea," says Hay, toasting guide Kenny Morrison, far right.

salmon aquaculture production in the hands of six multinational companies.

The globalization of salmon aquaculture, coupled with serious environmental concerns, has led to growing opposition and calls for reform. A major scourge is sea lice, which can kill fish by grazing on their flesh. In Ireland, Scotland, and Norway studies indicate that sea lice outbreaks at fish farms can have devastating effects on wild salmon and sea trout, a related species.

In western Scotland, where aquaculture is located because of sheltered lochs, wild salmon populations have declined far more dramatically than on the east coast, which has only one fish farm. Similar trends have been found in Ireland. In Norway one study showed that 86 percent of the young salmon migrating out of Sognefjorden —which has many fish farms near its mouth— were covered with lethal levels of lice.

Aquaculture companies are now working to solve the sea lice problem. But what really causes scientists to lose sleep is the continuing escape of massive numbers of farmed salmon. From the earliest years of aquaculture, salmon have escaped whenever seals chewed through pens in search of an easy meal, storms demolished cages, or fish were spilled during handling. But now, with 300 million farmed salmon being sold every year, the magnitude of the escape problem is enormous. Ten to 35 percent of the salmon on the spawning grounds of Norwegian rivers are farmed salmon. In Scotland nearly 300,000 farmed fish escaped last year alone.

Detailed studies by Norwegian scientists have shown that wild and farmed fish interbreed. The concern is that a hybrid fish, poorly adapted to life in the wild, will one day spread across the Atlantic. Studies have also found that farmed salmon do not reproduce in the wild nearly as well as native salmon—a phenomenon that, over time, could depress populations. In addition, individual strains of wild salmon have, over thousands of years, adapted to unique conditions in each of 2,600 Atlantic rivers. A genetically homogenous salmon, descended from aquaculture fish, could be ill suited to life in many rivers and could also leave the species less able to cope with threats such as disease and climate change.

"The prospect of losing this genetic variability forever is really frightening," says Torbjørn Forseth, aquatic research director at the Norwegian Institute for Nature Research.

Other problems dog the salmon aquaculture industry: fears that the explosion in farming will lead to the depletion of forage species, like mackerel, for fish-food pellets; charges—strongly denied by the farmers—that pellets high in dioxins taint aquaculture salmon; concerns that food and fecal waste from salmon farms have promoted toxic algae blooms that have led to closure of shellfishing in nearby waters; and outbreaks of disease around salmon aquaculture sites, such as the epidemic of infectious salmon anemia that led to the recent slaughter of 2.1 million tainted fish in Cobscook Bay, the locus of aquaculture in Maine. These cumulative problems have recently prompted Norway to establish a network of fjords and wild-salmon rivers where fish farming will be prohibited or restricted.

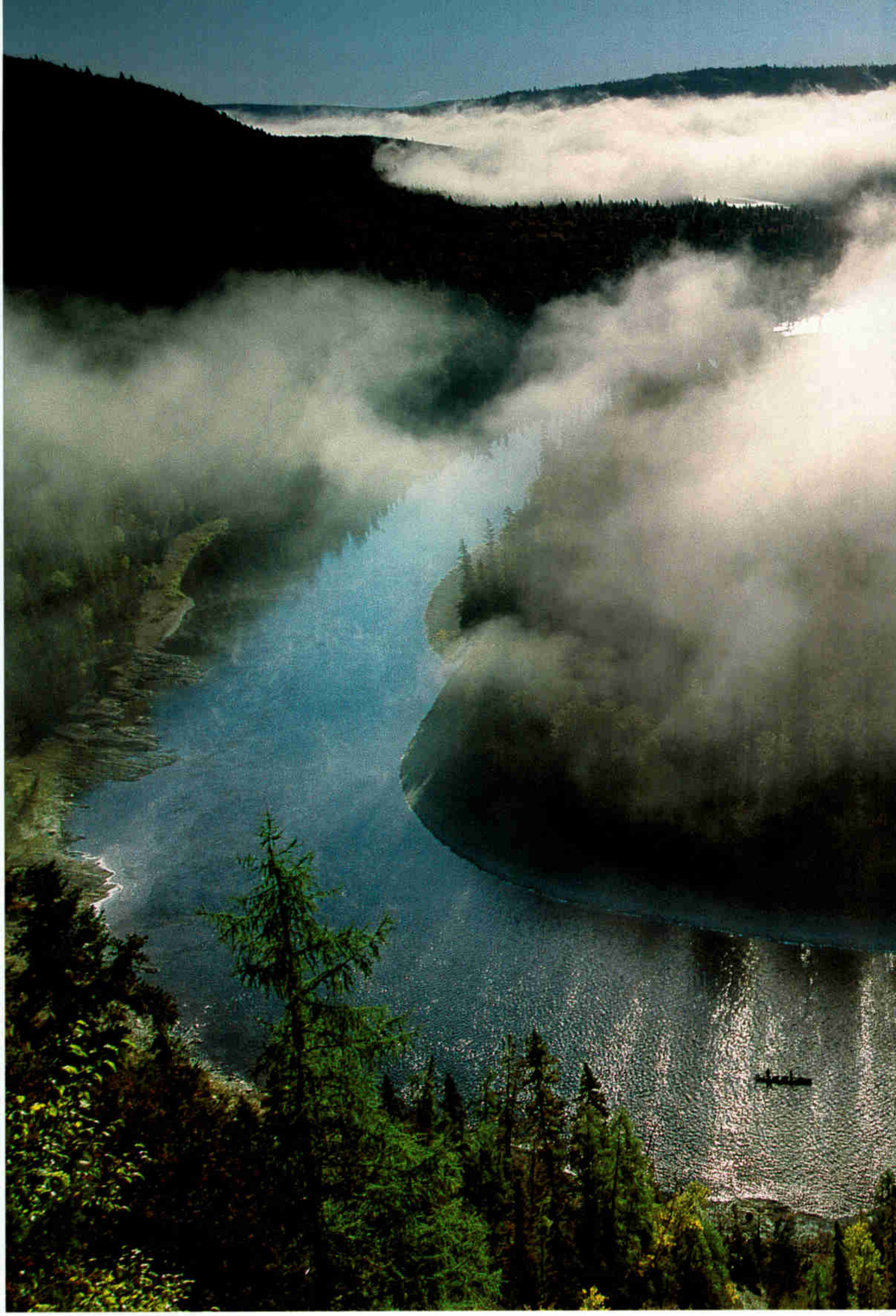
"We cannot have this rate of expansion in the salmon farming industry and at the same time save wild salmon," Forseth says. "It's just too fast."

One thing is certain: Although it is a struggle to preserve the Atlantic's remaining wild salmon, it is far more difficult to bring them back from the dead.

Anyone wanting a lesson in the rigors of salmon resurrection need only visit the ghost rivers of Maine, where a population of several hundred thousand wild salmon has, through three centuries of human abuse, been reduced to a few hundred.

In early November I join biologist Mitchell N. Simpson on the Narraguagus River, one of eight Down East Maine waterways where salmon have been listed under the federal Endangered Species Act. One of 34 rivers that once harbored wild salmon in Maine, the Narraguagus—about 30 miles long—never had a big run, probably around a thousand fish. But the construction of a half dozen mill dams in the 19th century, pollution, and overfishing have nearly wiped out the river's salmon population. Last year, despite the annual release of about

In Scotland farmed salmon outnumber wild by about 300 to one.



FISH OF DREAMS

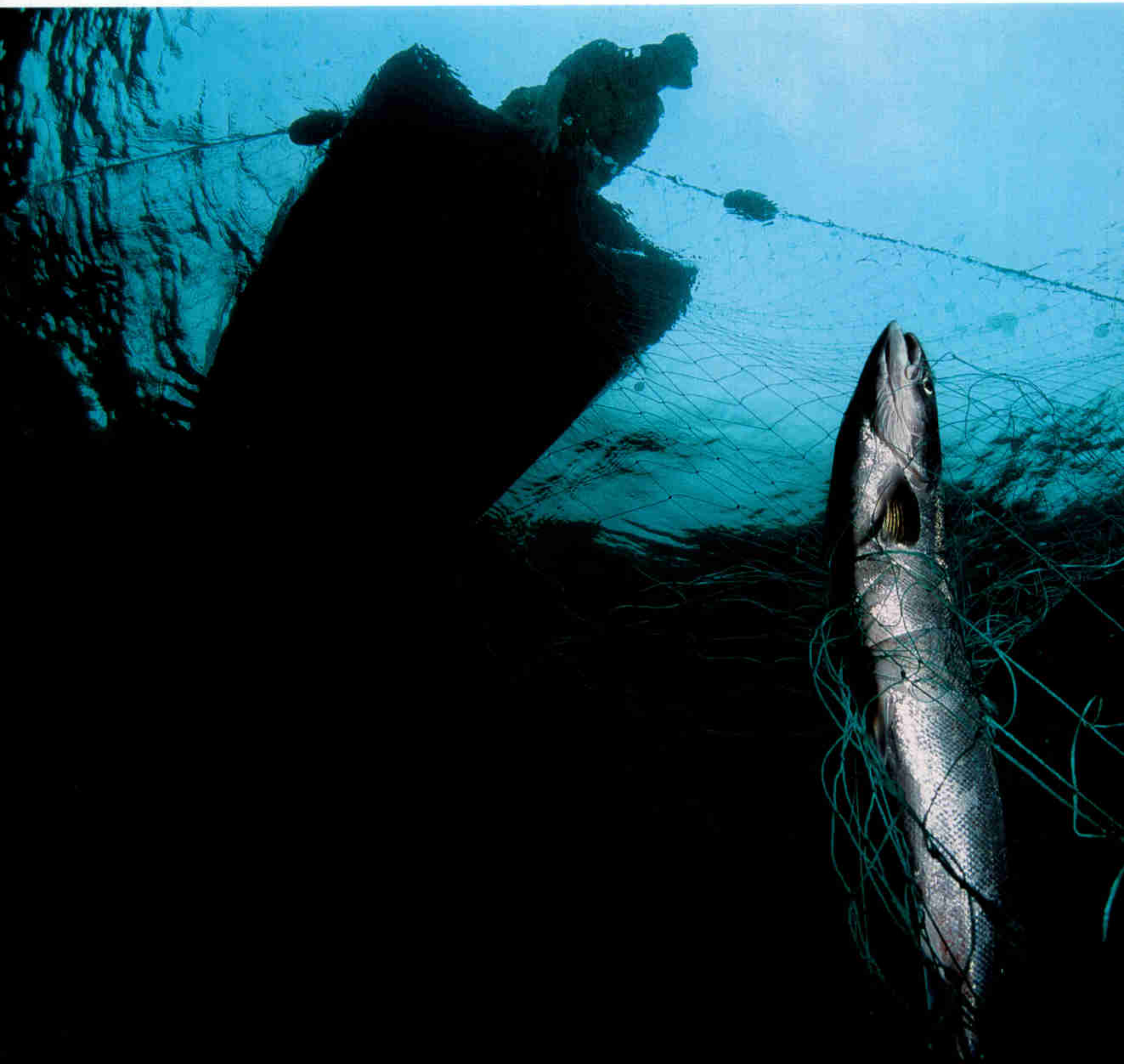
Fog and legends shroud eastern Canada's Restigouche River, where on the evening of June 23, 1990, Ken Jamieson, a retired executive, fought the largest Atlantic salmon ever caught in North America—a 72-pound, 68-inch-long behemoth, which he photographed and released.

200,000 salmon fry into the Narraguagus from government fish hatcheries, only eight returned to the river to spawn.

Simpson is a biologist with the Maine Atlantic Salmon Commission, a state agency charged with studying and restoring salmon populations. He has come to count the redds where salmon spawn, and we hop in a canoe and paddle five miles downriver. Simpson stands in the stern and scans the cobble for signs of spawning salmon. For nearly two hours, he sees nothing.

"Oh, there we are," Simpson finally says, paddling toward a redd—a patch of stones, ten feet long and four feet wide. It is lighter than the surrounding river bottom, as the female salmon, using her tail to dig a hole for her eggs, has swept the cobble clean of dark algae. Pulling out a GPS device, Simpson jots down the coordinates of the spawning bed, then moves on. By the end of our four-hour trip, we have spotted only a few redds. "We have as many biologists as we do fish," Simpson says.

State agencies are continuing the cleanup of Maine's salmon rivers, and conservation groups like the Atlantic Salmon Federation have launched a major effort to remove dams on the Penobscot River, the state's largest. But the problem in Maine, as in every other place salmon have disappeared, is that restoring wild runs is akin to bringing a comatose patient back to life. Once native salmon stocks disappear, hatchery fish have proved to be ill suited to recolonizing rivers. Along the Connecticut River, federal and state governments have spent a hundred million



dollars in the past 35 years to clean up the waterway, improve passage for salmon and other fish at dams, and build hatcheries. As many as 9.5 million salmon fry have been released annually into the Connecticut. The result? In 2002, 44 Atlantic salmon returned to spawn.

Similar hurdles await those trying to revive salmon populations in the Thames and the Rhine. The fact is, wildness is irreplaceable.

Fortunately for the Atlantic salmon, many of the rivers in which it thrives remain far from civilization. Although threatened in its southern range, the Atlantic salmon still has a healthy refuge in the far-flung, unpolluted rivers of Quebec, Labrador, Iceland, northern Norway, and Russia's Kola Peninsula. The salmon also has proved to be a resilient creature. If commercial fishing continues to decline, ocean conditions don't deteriorate further, and aquaculture is brought under tight control, these northern redoubts of the salmon should serve as the foundation for rebuilding the species.

WEBSITE EXCLUSIVE

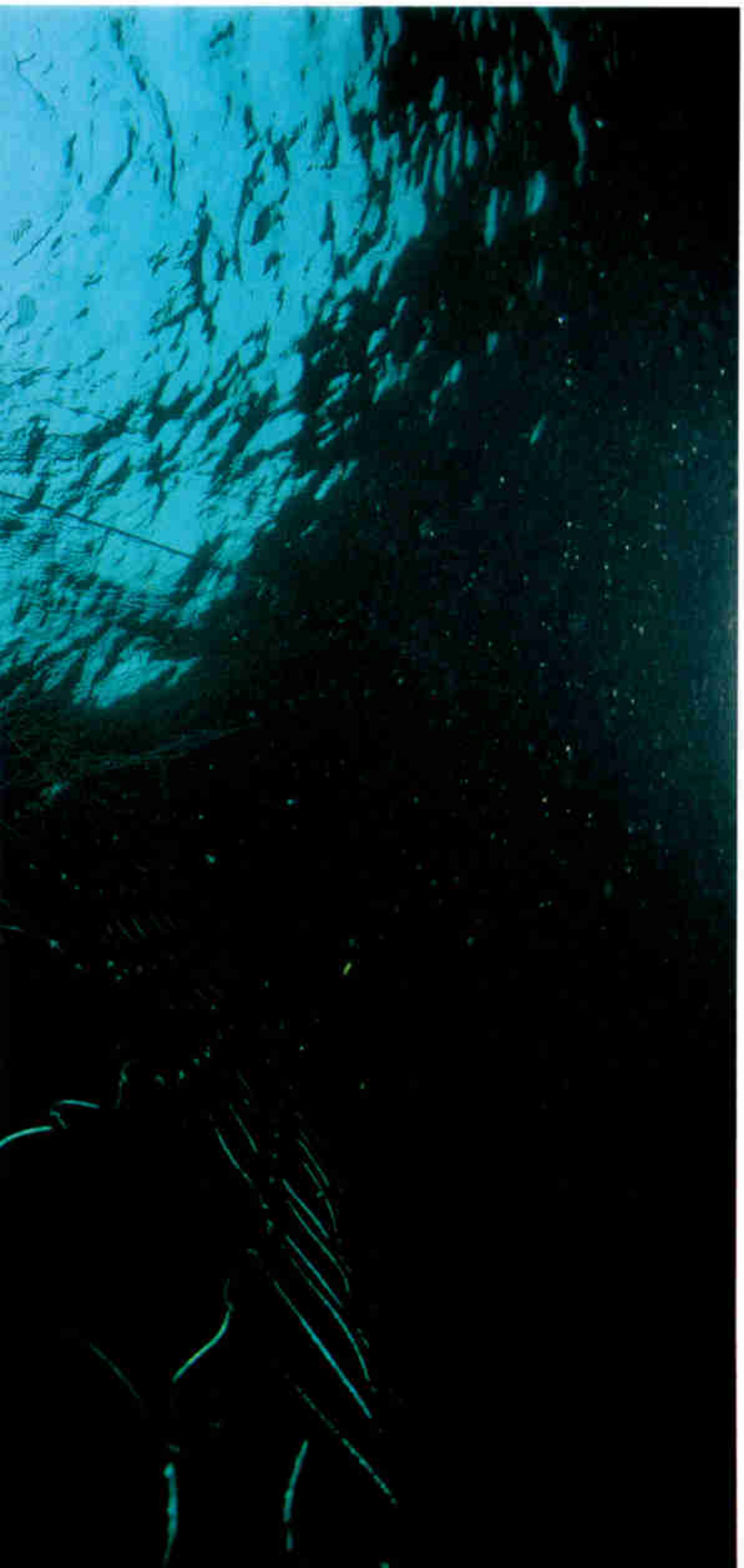
Find out more about the Atlantic salmon and its world, read notes from the field, and view more photographs at **nationalgeographic.com/ngm/0307**.

One such salmon stronghold is the St. Jean River on Quebec's Gaspé Peninsula. Winding through wooded hills, it is a gentle, limpid stream marked by deep pools of vivid jade. Bill Taylor of the Atlantic Salmon Federation has brought me to the St. Jean to show me one of Canada's finest salmon rivers, and on a warm, sunny July morning he entrusts me to veteran guide Austin Clark at a pool called Maitland. Seventy-five yards long, it harbors the sleek, undulating shapes of dozens of salmon, which have migrated 19 miles upstream from the sea.

I fish with a two-inch dry fly that skitters across Maitland's surface. Twice, toward the tail end of the pool, a salmon hits my fly, and twice I yank it out of the fish's mouth. The third time I restrain myself, and an enormous salmon takes off with the fly, leaping repeatedly before holding its ground at the bottom of the pool.

Finally I tug it to shore. Clark puts one hand around its fat tail, slips another under its big belly, and places it in a long gray box, where he measures it and takes scale samples. It is a 42-inch, 30-pound female, carrying more than 10,000 eggs. It is the biggest freshwater fish I have ever caught, and as we prepare to release it, I understand why Ted Williams—a fanatical Atlantic salmon angler—enjoyed catching such a fish as much as hitting a home run. "The Atlantic salmon is a power-packed, leaping, silver thing of beauty," he once wrote, "and God, I hope it lives forever."

With both hands Clark steadies the salmon in the cool water. Then it is gone, melting into the green depths of the Maitland pool. □



END OF THE LINE

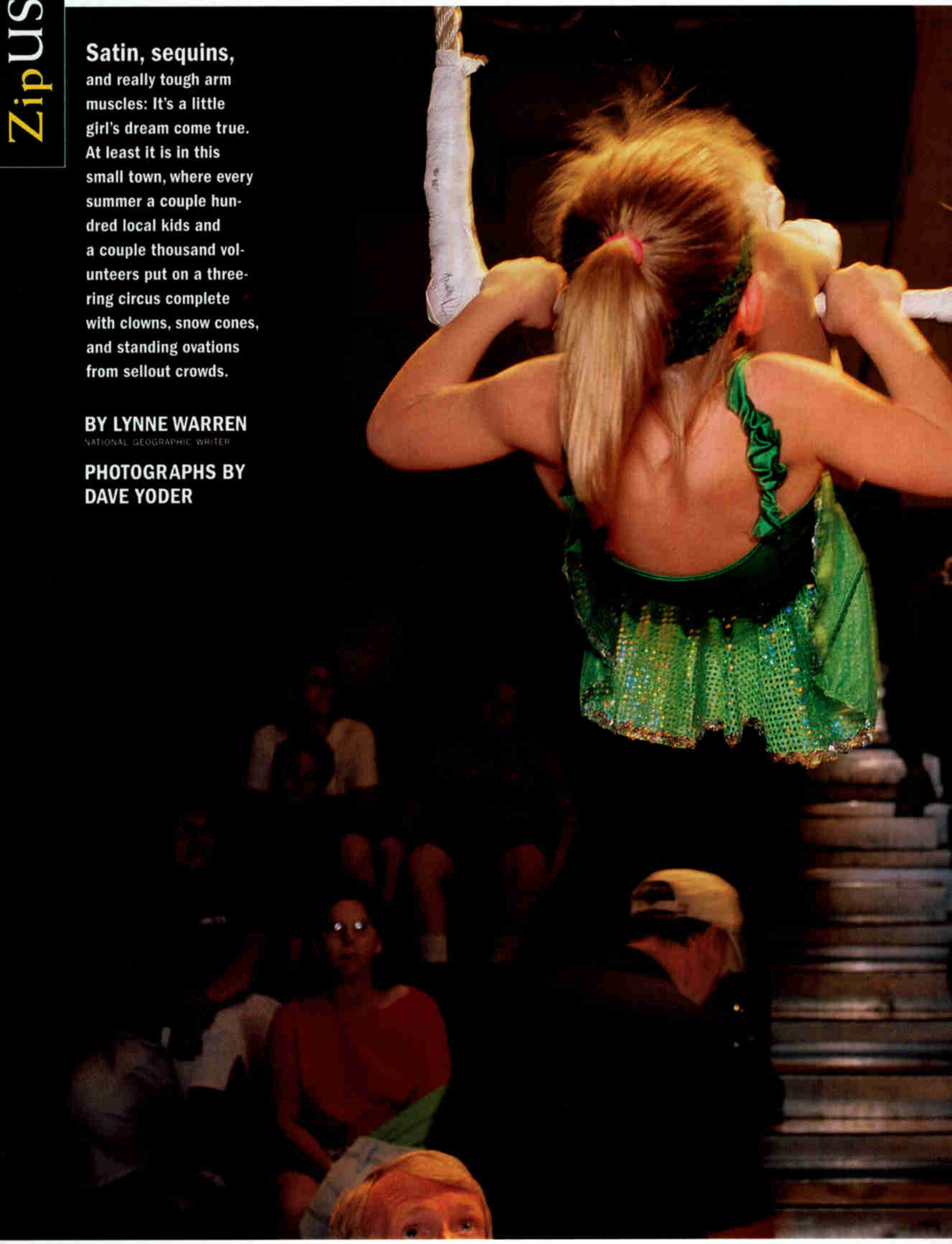
A fisherman in a curragh retrieves his only catch of the day in western Ireland, where a traditional fishery has waned along with the salmon. But at least one researcher believes the wild salmon will be back. "Remember," he says, "they rode out the last ice age."

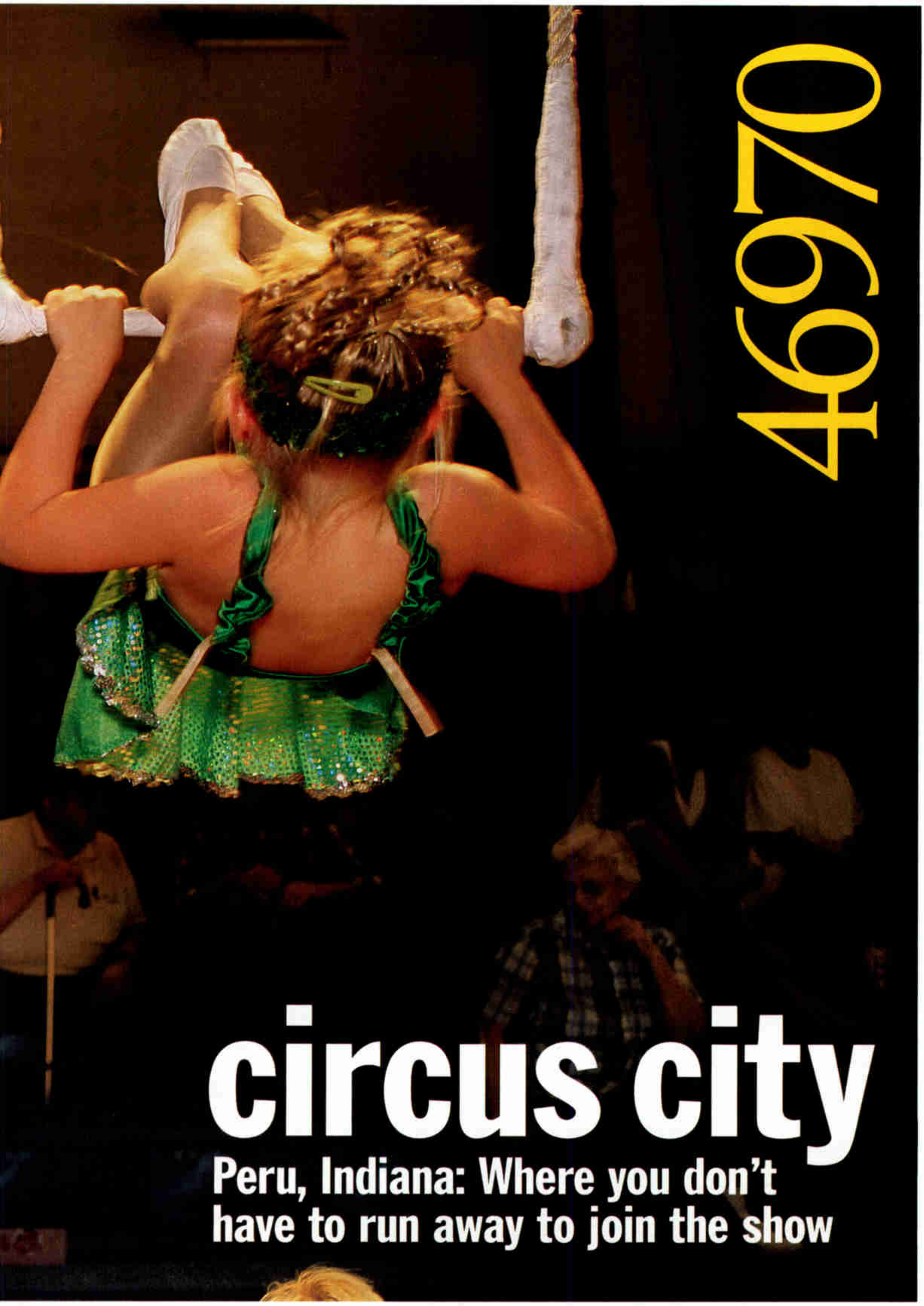
PERU, INDIANA

Satin, sequins, and really tough arm muscles: It's a little girl's dream come true. At least it is in this small town, where every summer a couple hundred local kids and a couple thousand volunteers put on a three-ring circus complete with clowns, snow cones, and standing ovations from sellout crowds.

BY LYNNE WARREN
NATIONAL GEOGRAPHIC WRITER

PHOTOGRAPHS BY DAVE YODER




0769
460
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Peru, Indiana: Where you don't
have to run away to join the show

46970

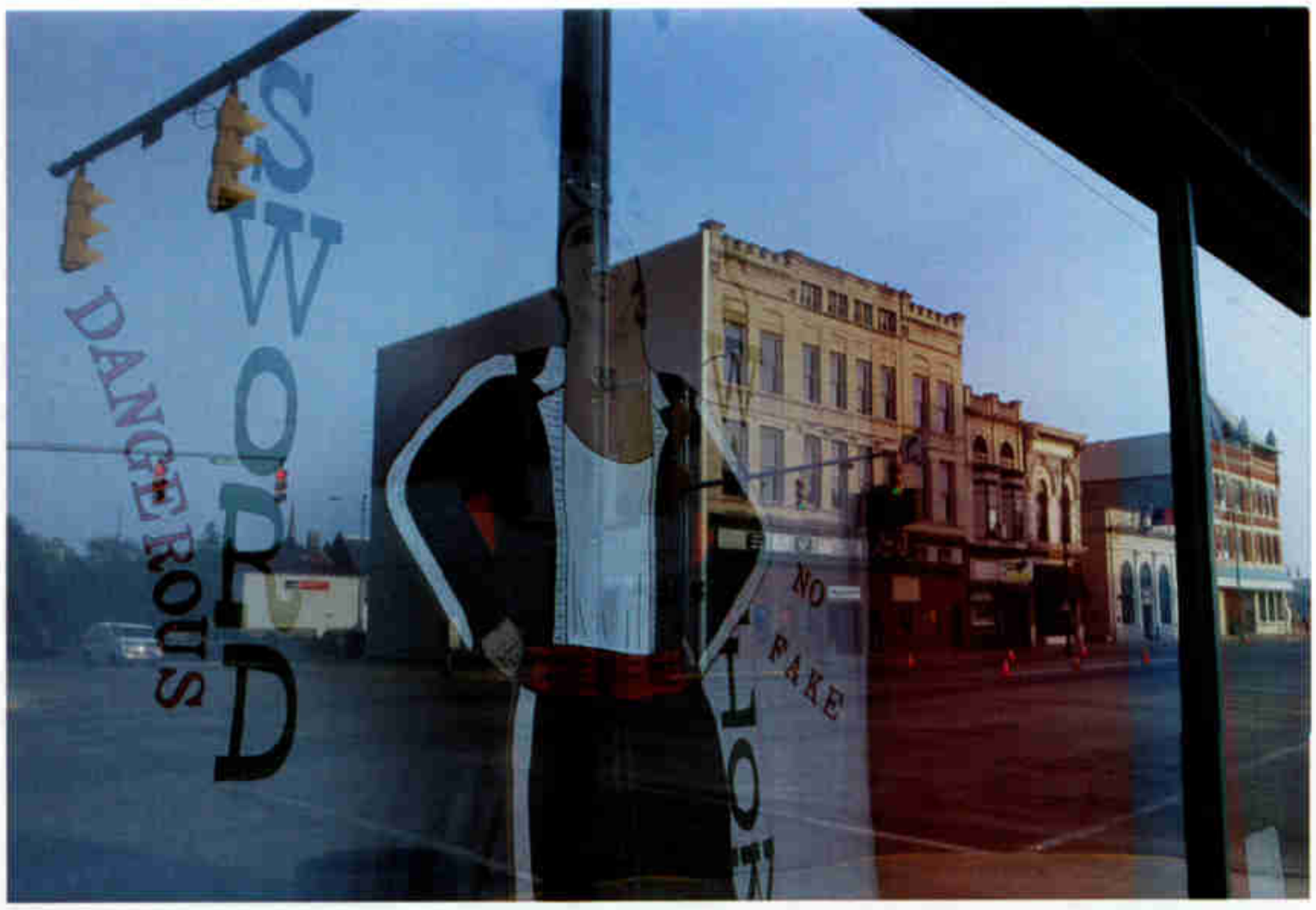
POPULATION: 13,000

ANNUAL CIRCUS ATTENDANCE: 13,000

FIRST YEAR OF THE PERU AMATEUR CIRCUS: 1959

COSTUMES WORN IN EACH SHOW: 500-plus, for 220 kids in 25 acts

KIDS WHO HAVE TRAVELED FROM INDIANA TO EUROPE AND PERFORMED BEFORE ROYALTY: 18



Big-top mania even takes over downtown shop windows (top) during the July circus festival. Preparations begin months before. Burly guys become bases for multi-girl stacks, and flyweight acrobats flash smiles—even when hanging by their hair. Trying a new balance trick was "sort of scary at first," says nine-year-old Ashlyn Koontz (upside down, at left). "I tipped over a couple times. But once I learned how to do it, it was really fun."

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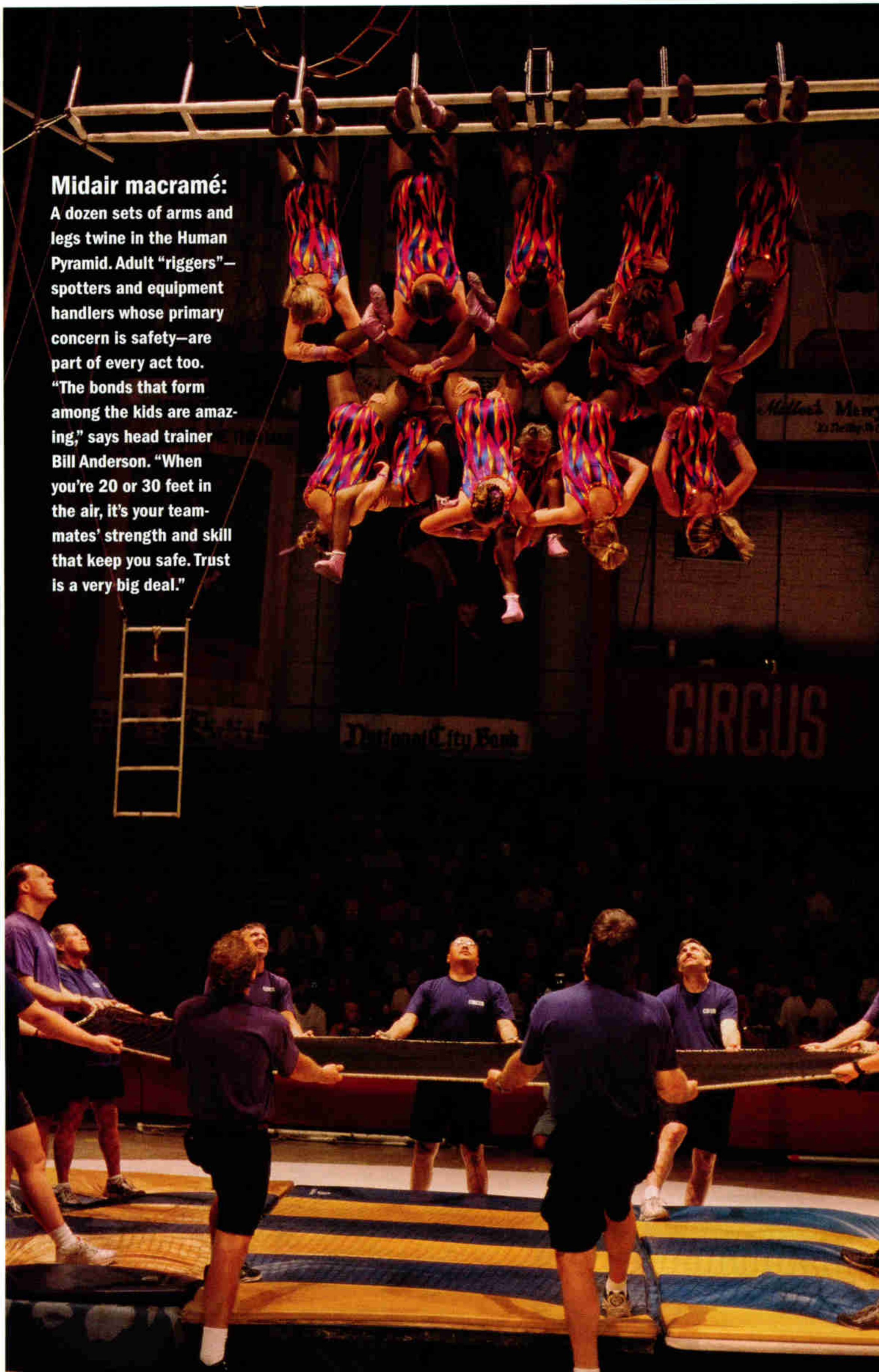
Dr. Roger Payne has been at the forefront of whale research and ocean science since 1971. In addition to "Songs of the Humpback Whale," he is responsible for the IMAX film "Whales," the films "In the Company of Whales" and "Finite Oceans", and the acclaimed book "Among Whales."

Photo By Iain Kerr



Midair macramé:
A dozen sets of arms and legs twine in the Human Pyramid. Adult "riggers"—spotters and equipment handlers whose primary concern is safety—are part of every act too. "The bonds that form among the kids are amazing," says head trainer Bill Anderson. "When you're 20 or 30 feet in the air, it's your teammates' strength and skill that keep you safe. Trust is a very big deal."

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Fig. 2

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Fig. 3

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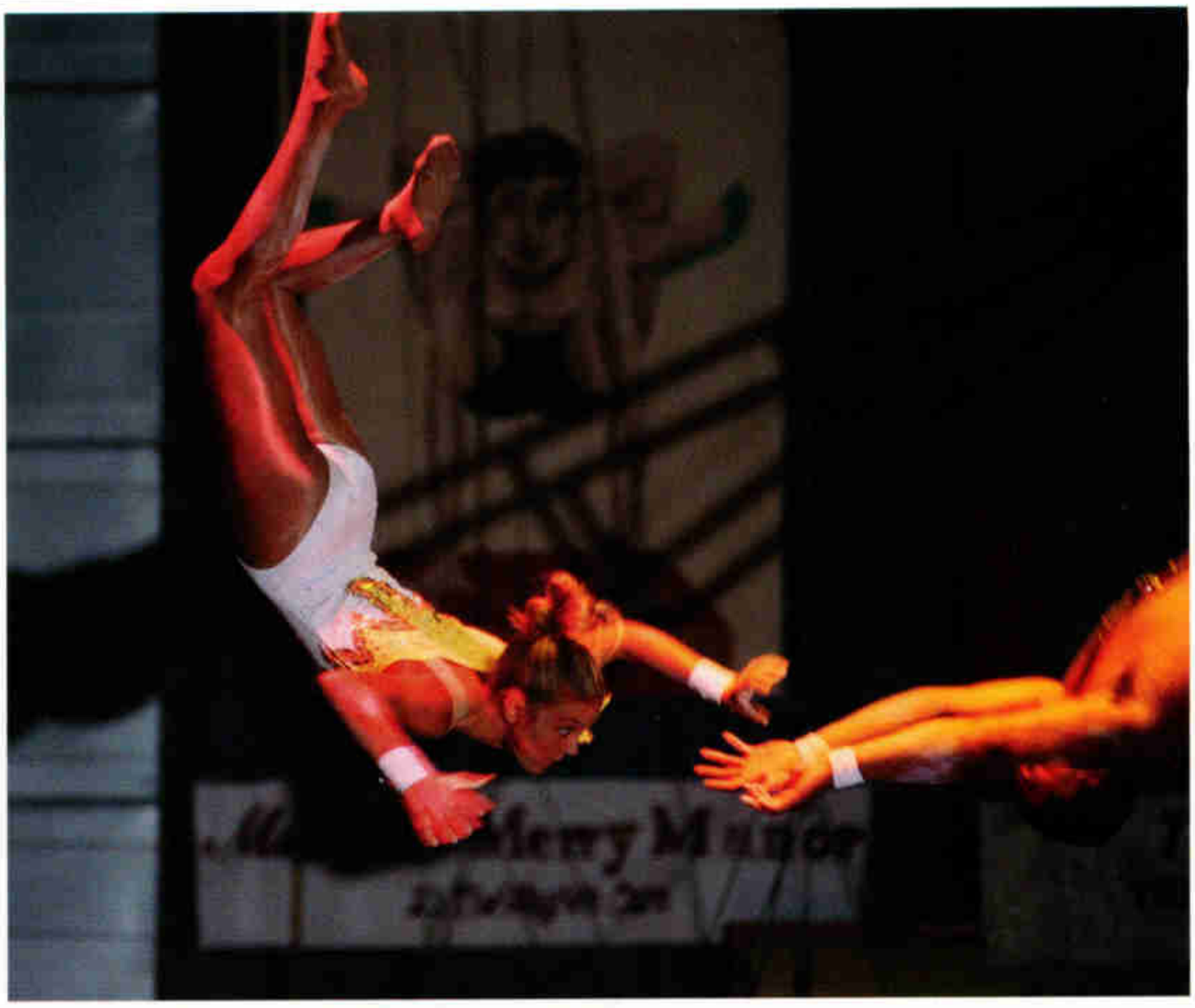
Practice pays off

when a 12-year-old can stroll a spotlit high wire (below) as nimbly as another child might flop on a couch. The acts are authentic circus classics: In 44 years some two dozen Peru performers have gone on to professional circus careers.



For the 2002 grand finale teens soared from trapezes three stories above center ring. Coming out of a twisting somersault, a flier reached for her catcher (above). On the ground friends clustered, fingers crossed, breath held (left). Would she make it? Then hands and wrists locked together, and cheering delight roared through the arena. Flowers and proud hugs followed (below). "This is really just a summer recreation program," Anderson says modestly. Then he smiles. "But our kids get to do things most kids only dream about." □

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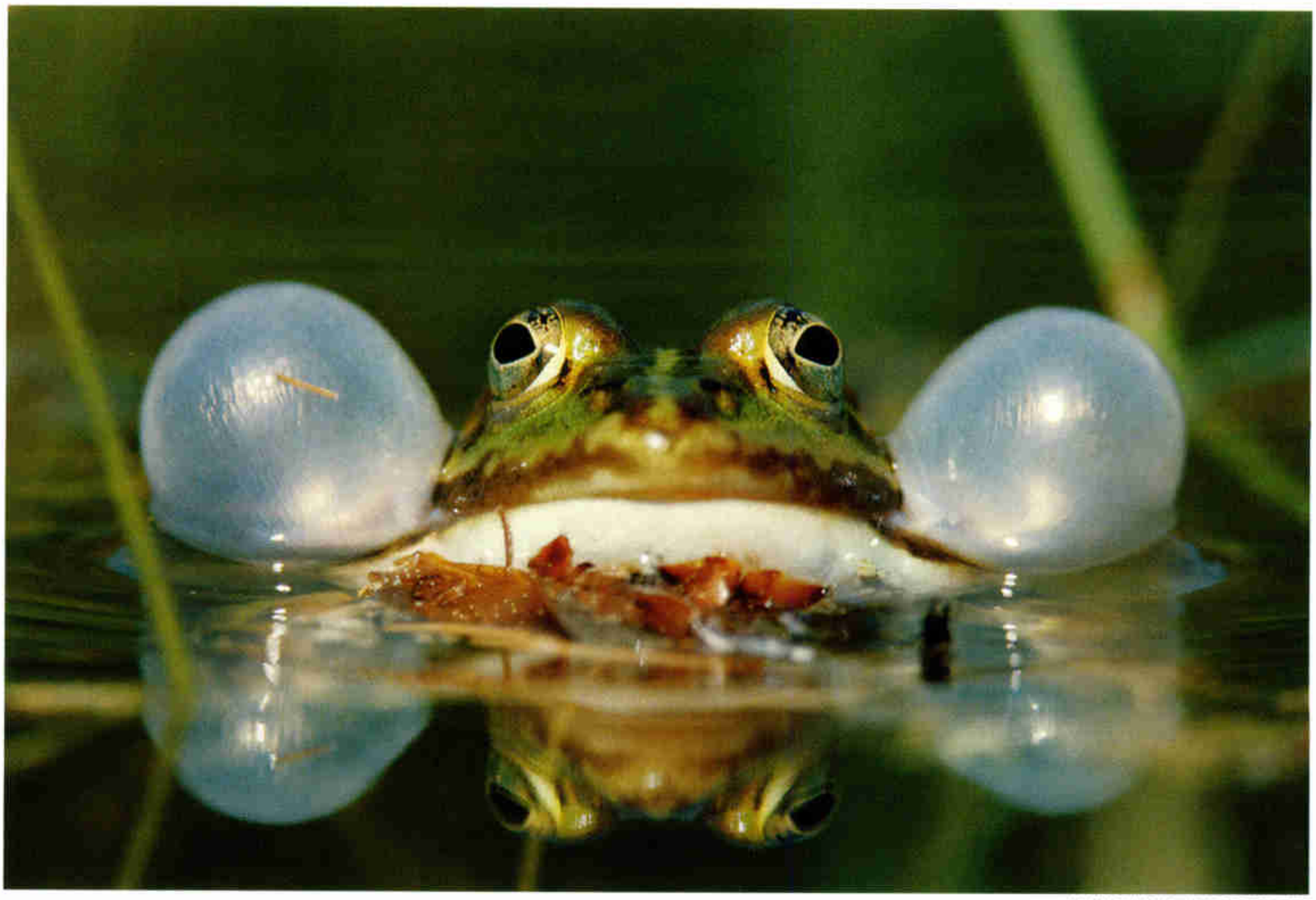


KONRAD WOTHE, MINDEN PICTURES

ANIMAL ATTRACTION

Froggy Went A-Courtin'

It's impossible to know whether this horned frog's cheek-ballooning love song won him a mate, but it certainly got the attention of the magazine's editors. "The photo stops you, makes you look," says director of photography Kent Kobersteen. But the competition was stiff—and not just for one frog in search of a female. We reviewed some 2,000 images from more than 200 photographers for this month's story on the sex lives of animals. Most GEOGRAPHIC stories are shot by one photographer, but for this subject "it was unrealistic," says Kobersteen. "A photographer could spend an entire career and not encounter the number of mating situations portrayed in this article."

WEBSITE EXCLUSIVE

Cut it or keep it? Find out more about what tipped the balance for this photo and send it as an electronic greeting card at **nationalgeographic.com/ngm/0307**.

ON ASSI

ON THE ROAD, IN THE FIELD

KOREA'S DMZ

Dressed for Distress

Reporting a story with a fully armed escort

That's North Korea looming behind senior writer **Tom O'Neill** (below) and U.S. Army Capt. Brian Davis in the Joint Security Area of the Korean Demilitarized Zone (DMZ), the place where the opposing sides of a 50-year-old truce come closest to each other. To accompany South Korean troops on a pre-dawn border patrol, the pair donned battle-dress uniforms and daubed their faces with camouflage paint. Captain Davis's first order to Tom: "Do *not* call it makeup!"

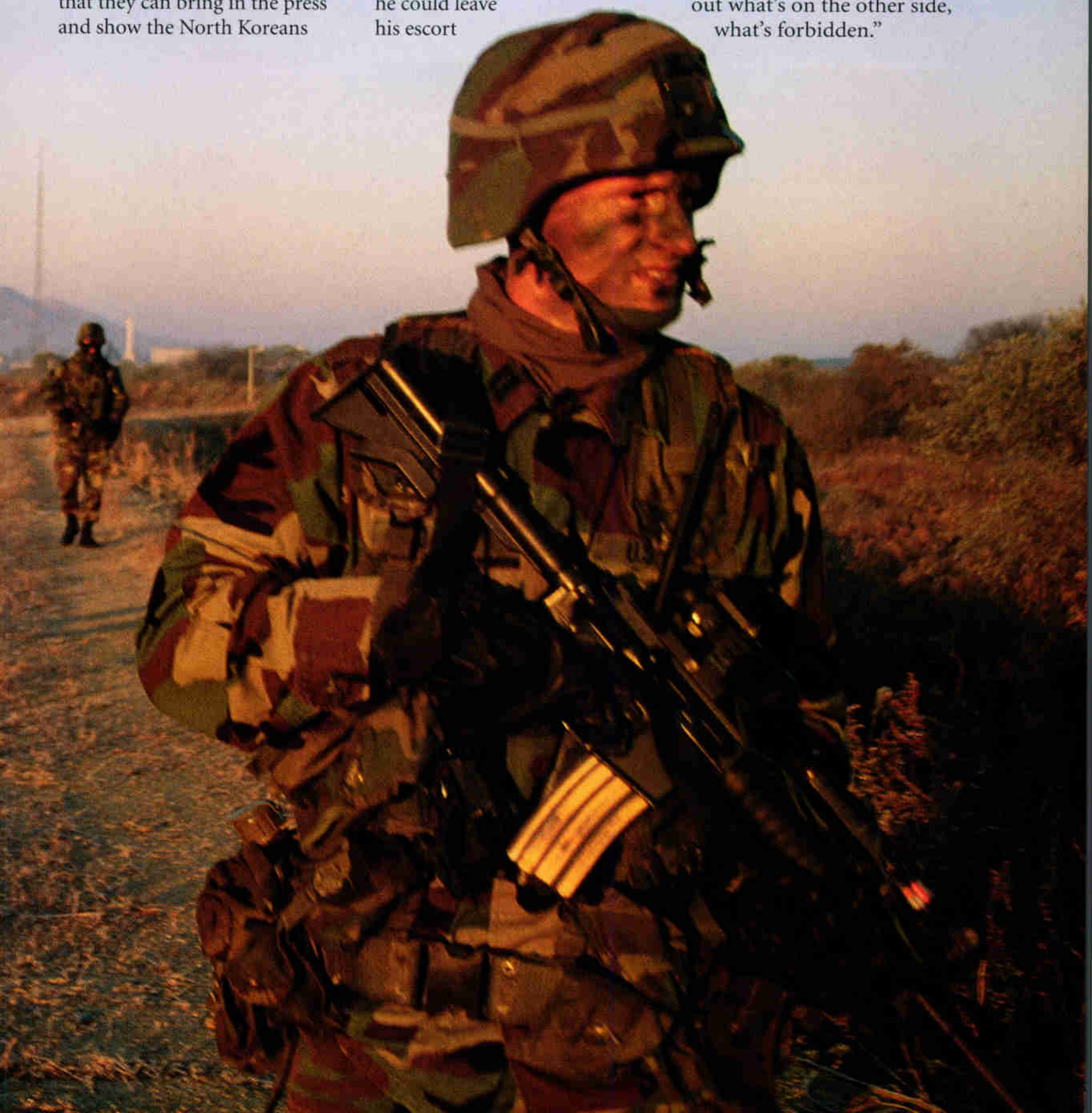
MICHAEL YAMASHITA

GNMENT

COVERING THE WORLD

Wearing a blue press badge and conspicuously unarmed, Tom drew more than the usual attention from North Koreans on their side of the DMZ. "The South Koreans wanted me and photographer Mike Yamashita to be seen," he says. "They're proud that they can bring in the press and show the North Koreans they have nothing to hide."

Whenever Tom visited the DMZ, an armed military escort went with him every step. "I felt protected," he says. "The only fear I felt was in the manic traffic on the way back to Seoul." Still, he found himself wishing he could leave his escort behind and travel more freely in the rugged—and quite beautiful—border zone. "I kept looking into North Korea and wondering what life was like there," he recalls. "What do they think? Do they truly hate us? My instinct is to find out what's on the other side, what's forbidden."



THREE PEAKS

Howdy, London

As a boy, **Joel Sartore** wrote to John Wayne five times asking for an autograph, and got five different autographed photographs back. "I still have them," he says, "though the ink ran on one of them after I hit it with a squirt gun." So when he stopped in London on his way to photograph the three-peak climb in Scotland, England, and Wales, he visited Madame Tussaud's Wax Museum to see the Duke (right).

Joel has traveled the world over, but he'd never been to England before. "I used to hear the food wasn't good, so I never tried to get assignments there," he says. Now, assignment in hand, "I stalled in London for a couple of days, being totally out of shape and not really wanting to cover mountain climbers. Madame Tussaud's was the high point. I liked the statue of Princess Diana, but her rear end was dirty where people had pawed her."

Eventually he made it to the three peaks—even reached the top of one. ("There's a train," he notes.) And British cuisine, which now receives worldwide acclaim? "The ice cream was excellent."

JOHN TAPPIN

WORLDWIDE

STEVE ANDERSON

Rolling in a "German wheel" at the Peru, Indiana, circus made photographer **David Yoder** feel as if he was in a front-loading washing machine. "I tried the easiest trick: rolling around in a circle," says David. "It was disorienting, but if you shift your body weight a certain way, you can keep the momentum going. After ten minutes, I was sore in places I never knew I had muscles." David makes his home in Italy, but he was born in Fort Wayne, Indiana, about 85 miles from Peru. "A photographer dreams of visiting exotic places for NATIONAL GEOGRAPHIC. My first assignment took me right back to where I grew up," he says.

For this month's article on Atlantic salmon, writer **Fen Montaigne** had a tough assignment: Spend a couple of months visiting the most beautiful places in the Northern Hemisphere. "Salmon rivers happen to be located in gorgeous landscapes," he says with a grin. "These fish only flourish in unspoiled places. They tend to disappear wherever there's too much interference from humanity." An avid fly fisherman, Fen took his fishing gear with him and managed to get in some angling in Iceland and Quebec. The burden of research, you understand.

Even experts get fooled by the reproductions of Shang era bronzes made at the Xinxiang City Museum. In preparation for his article on ancient China, **Peter Hessler** (right, at right) went there with photographer **Lou Mazzatenta** and watched skilled technician Wang Xuemei create a mold for a Bronze Age bowl, working from a photo on the table. Peter has lived in China for six years, speaks Mandarin proficiently, and as Lou notes, "moves in and out of Chinese society easily." That made Lou a little nervous: "Peter eats at tiny, local restaurants where the waiters don't speak English and his bill was about 50 cents per dinner; I ate in hotels, where meals cost a lot more. I was afraid the accountants at NATIONAL GEOGRAPHIC would compare our expenses and accuse me of overspending."

O. LOUIS MAZZATENTA

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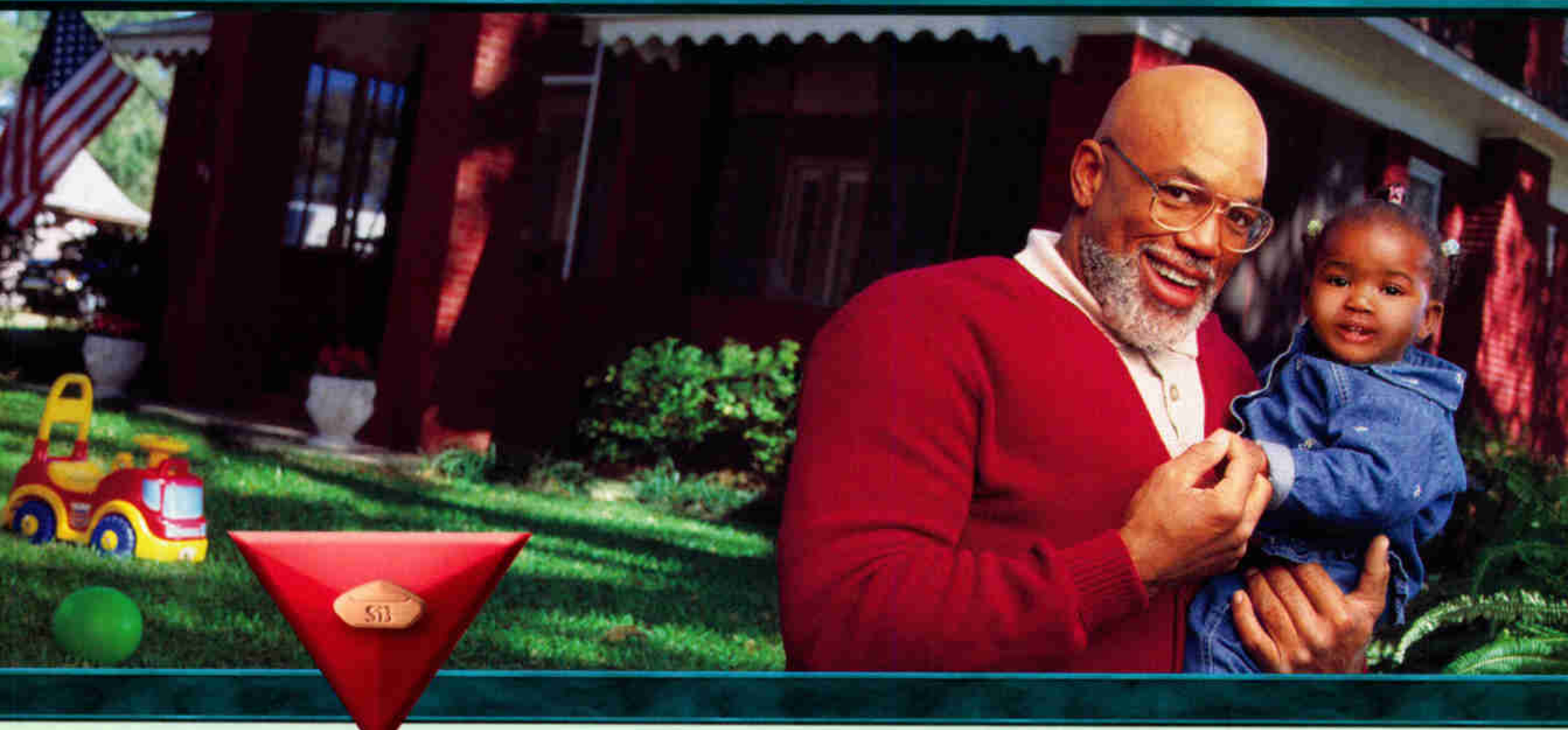

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"I've got my routine down: I stay active, and try my best to eat healthier meals. To help me stay on track, my doctor added *Avandia*. It makes my body more responsive to its own natural insulin, so I can control my blood sugar more effectively.

"I started on *Avandia* over a year ago, and while not everyone gets the same results, my blood sugar has never been better. I know *Avandia* is helping me to be stronger than diabetes. That's something I can really wrap my arms around."

Avandia, along with diet and exercise, helps improve blood sugar control. It may be prescribed alone, with metformin, sulfonylureas, or insulin. When taking *Avandia* with sulfonylureas or insulin, patients may be at increased risk for low blood sugar. Ask your doctor whether you need to lower your sulfonylurea or insulin dose.

Some people may experience tiredness, weight gain or swelling with *Avandia*.

Avandia may cause fluid retention or swelling which could lead to or worsen heart failure, so you should tell your doctor if you have a history of these conditions. If you experience an unusually rapid increase in weight, swelling or shortness of breath while taking *Avandia*, talk to your doctor immediately. In combination with insulin *Avandia* may increase the risk of other heart problems. Ask your doctor about important symptoms and if the combination continues to work for you. *Avandia* is not for everyone. *Avandia* is not recommended for patients with severe heart failure or active liver disease.

Also, blood tests to check for serious liver problems should be conducted before and during therapy. Tell your doctor if you have liver disease, or if you experience unexplained tiredness, stomach problems, dark urine or yellowing of skin while taking *Avandia*.

If you are nursing, pregnant or thinking about becoming pregnant, or premenopausal and not ovulating, talk to your doctor before taking *Avandia*.

See important patient information on the adjacent page.

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What is *Avandia*?

Avandia is one product in a class of prescription drugs called thiazolidinediones (thigh-a-zol-a-deen-die-owns) or TZDs. It is used to treat type 2 diabetes by helping the body use the insulin that it is already making. *Avandia* comes as pills that can be taken either once a day or twice a day to help improve blood sugar levels.

How does *Avandia* treat type 2 diabetes?

If you have type 2 diabetes, your body probably still produces insulin but it is not able to use the insulin efficiently. Insulin is needed to allow sugar to be carried from the bloodstream into many cells of the body for energy. If insulin is not being used correctly, sugar does not enter the cells very well and builds up in the blood. If not controlled, the high blood sugar level can lead to serious medical problems, including kidney damage, blindness and amputation.

Avandia helps your body use insulin by making the cells more sensitive to insulin so that the sugar can enter the cell.

How quickly will *Avandia* begin to work?

Avandia begins to reduce blood sugar levels within 2 weeks. However, since *Avandia* works to address an important underlying cause of type 2 diabetes, insulin resistance, it may take 8 to 12 weeks to see the full effect. If you do not respond adequately to your starting dose of *Avandia*, your physician may increase your daily dose to improve your blood sugar control.

How should I take *Avandia*?

Your doctor may tell you to take *Avandia* once a day or twice a day (in the morning and evening). It can be taken with or without meals. Food does not affect how *Avandia* works. To help you remember to take *Avandia*, you may want to take it at the same time every day.

What if I miss a dose?

<u>If your doctor has prescribed *Avandia* for use once a day:</u>

- As soon as you remember your missed dose, take one tablet anytime during the day.
- If you forget and go a whole day without taking a dose, don't try to make it up by adding another dose on the following day. Forget about the missed dose and simply follow your normal schedule.

<u>If your doctor has prescribed *Avandia* for use twice a day:</u>

- As soon as you remember the missed dose, take one tablet.
- Take the next dose at the normal time on the same day.
- Don't try to make up a missed dose from the day before.
- You should never take three doses on any single day in order to make up for a missed dose the day before.

Do I need to test my blood for sugar while using *Avandia*?

Yes, you should follow your doctor's instructions about your at-home testing schedule.

Does *Avandia* cure type 2 diabetes?

Currently there is no cure for diabetes. The only way to reduce the effects of the disease is to maintain good blood sugar control by following your doctor's advice for diet, exercise, weight control, and medication. *Avandia*, alone or in combination with other antidiabetic drugs (i.e., sulfonylureas, metformin, or insulin), may improve these other efforts by helping your body make better use of the insulin it already produces.

Can I take *Avandia* with other medications?

Avandia has been taken safely by people using other medications, including other antidiabetic medications, birth control pills, warfarin (a blood thinner), Zantac® (ranitidine, an antiulcer product from GlaxoSmithKline), certain heart medications, and some cholesterol-lowering products. You should discuss with your doctor the most appropriate plan for you. If you are taking prescription or over-the-counter products for your diabetes or for conditions other than diabetes, be sure to tell your doctor. Sometimes a patient who is taking two antidiabetic medications each day can become irritable, lightheaded or excessively tired. Tell your doctor if this occurs; your blood sugar levels may be dropping too low, and the dose of your medication may need to be reduced.

What are the possible side effects of *Avandia*?

Avandia was generally well tolerated in clinical trials. The most common side effects reported by people taking *Avandia* were upper respiratory infection (cold-like symptoms) and headache. When taking *Avandia* with sulfonylureas or insulin, patients may be at increased risk for low blood sugar. Ask your doctor whether you need to lower your sulfonylurea or insulin dose.

Some people may experience tiredness, weight gain, or swelling with *Avandia*.

Avandia may cause fluid retention or swelling which could lead to or worsen heart failure, so you should tell your doctor if you have a history of these conditions. If you experience an unusually rapid increase in weight, swelling or shortness of breath while taking *Avandia*, talk to your doctor immediately. In combination with insulin, *Avandia* may increase the risk of other heart problems. Ask your doctor about important symptoms and if the combination continues to work for you. *Avandia* is not for everyone. *Avandia* is not recommended for patients with severe heart failure or active liver disease.

Also, blood tests to check for serious liver problems should be conducted before and during therapy. Tell your doctor if you have liver disease, or if you experience unexplained tiredness, stomach problems, dark urine or yellowing of skin while taking *Avandia*.

If you are nursing, pregnant or thinking about becoming pregnant, or premenopausal and not ovulating, talk to your doctor before taking *Avandia*, as *Avandia* may increase your chance of becoming pregnant.

Who should not use *Avandia*?

You should not take *Avandia* if you are in the later stages of heart failure or if you have active liver disease. The following people should also not take *Avandia*: People with type 1 diabetes, people who experienced yellowing of the skin with Rezulin® (troglitazone, Parke-Davis), people who are allergic to *Avandia* or any of its components and people with diabetic ketoacidosis.

Why are laboratory tests recommended?

Your doctor may conduct blood tests to measure your blood sugar control. Blood tests to check for serious liver problems should be conducted before starting *Avandia*, every 2 months during the first year, and periodically thereafter.

It is important that you call your doctor immediately if you experience unexplained symptoms of nausea, vomiting, stomach pain, tiredness, anorexia, dark urine, or yellowing of the skin.

How should I store *Avandia*?

Avandia should be stored at room temperature in a childproof container out of the reach of children. Store *Avandia* in its original container.

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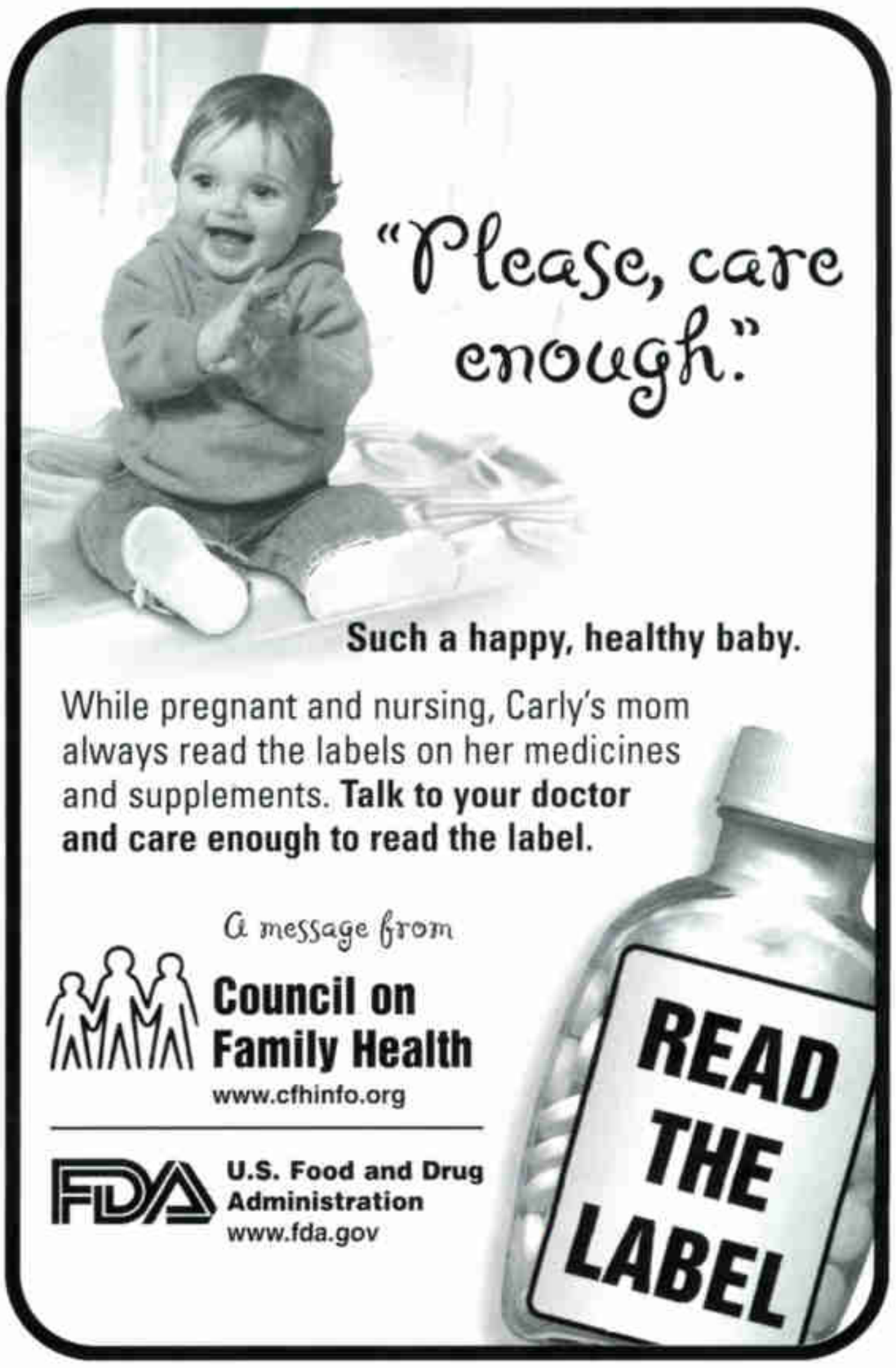

Flashback

UNDERWOOD & UNDERWOOD

DMZ

Changing Sides

Korea wasn't yet split in two when its former minister of war, Yun Ung-ryeol, center, was photographed with his family around 1910—the same year Japan began its 35-year occupation of the country. But political upheaval still divided the nation, and would soon tear the Yun family apart.

Ung-ryeol's son Yun Chi-ho, standing, became an advocate of Korean sovereignty. After being arrested by the Japanese on false charges in 1911 and serving four hard years in prison, he chose to remain silent on the subject of foreign rule. Then in the late 1930s Yun Chi-ho was persuaded—some say coerced—to make speeches praising Tokyo's leadership, even as its grip tightened on Korea before World War II. Now many remember the once fervent nationalist as a collaborator.

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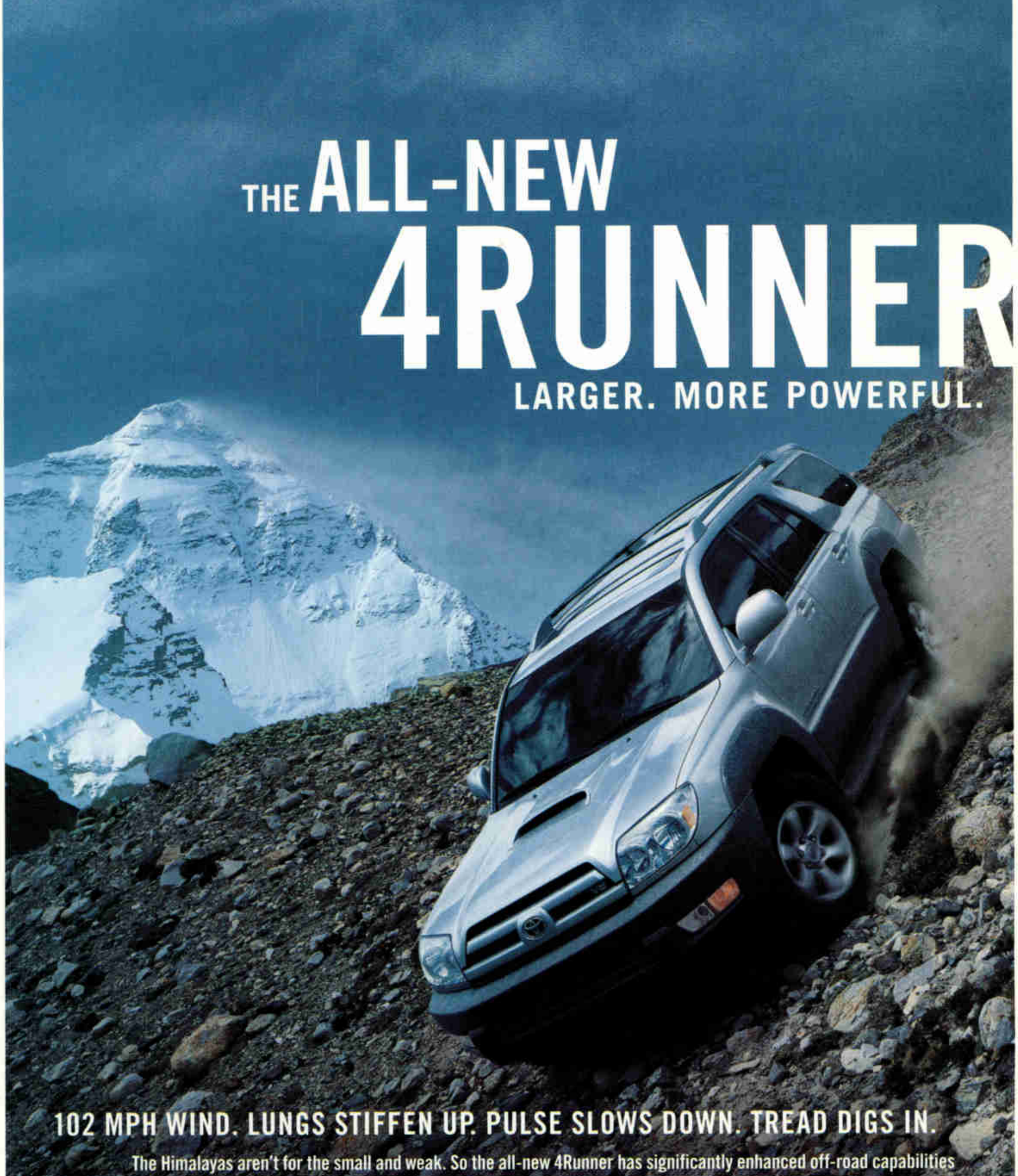

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